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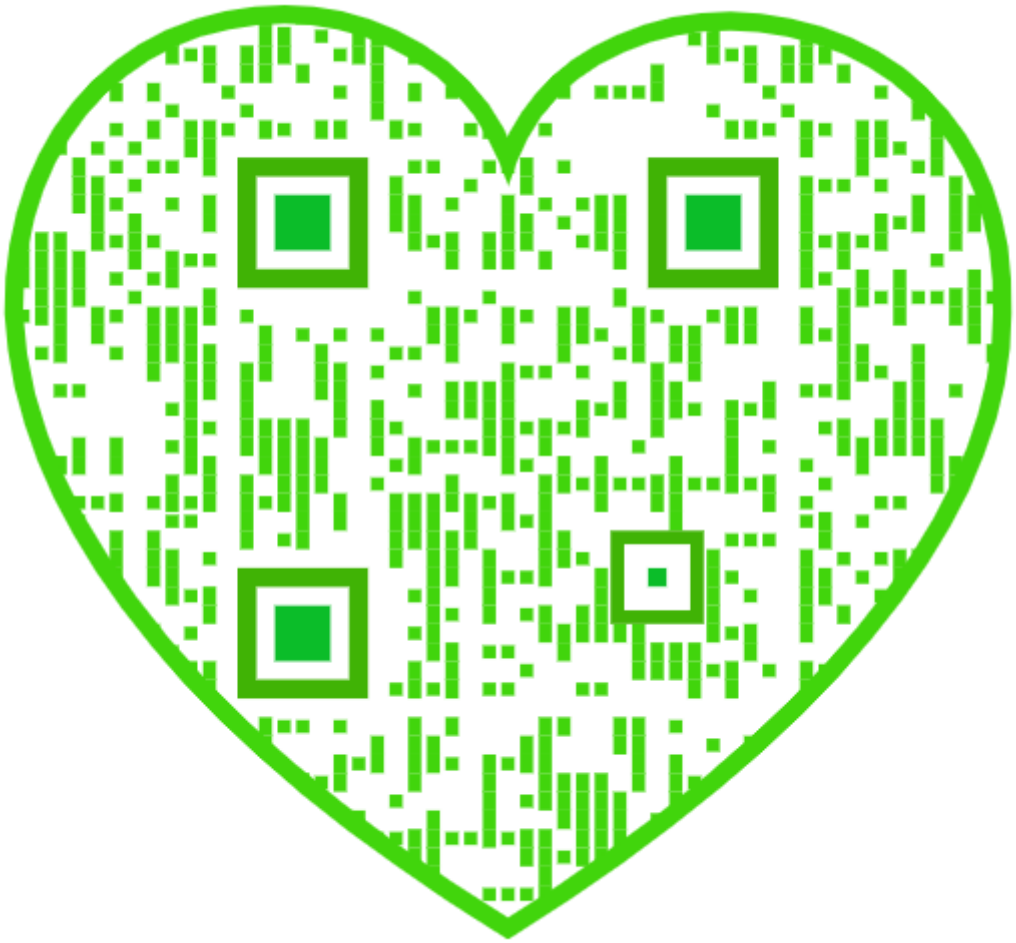
THE EVERREADY PIPE AND ELBOW CHART



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NEW BOOK OF INSTRUCTION AND TABLES

FOR USE WITH

THE EVERREADY PIPE AND ELBOW CHART

(Designed for Sheet Metal and Boiler Workers)

By

M. W. PEHL

SECOND EDITION
REVISED AND ENLARGED

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Preface

IN this second edition of the Everready Pipe & Elbow Chart the author has endeavored to embody in the booklet a number of tables of weights and other data that is very necessary for every mechanic, foreman, superintendent and estimator to have in as compact a form as possible. A number of these charts, tables, etc., have been taken from books, periodicals and magazines, for which due credit is given.

To the mechanic, the booklet furnishes exact dimensions for cutting out patterns for pipes, ducts and elbows; also proper allowances for the small end of pipes, so that they will fit properly.

To the foreman, it gives correct angles for mitre lines of all kinds of elbows, and a good short method of cutting elbow patterns. It also gives the weights of round and rectangular ducts and elbows, areas and circumference of pipes, including laps, weights of iron, friction in ducts, the loss of power due to friction, correct radius in elbows, the equalization of pipe diameters, flue and register dimensions, and the carrying capacity of ducts.

To the superintendent, it furnishes information relative to the successful operation of a heating or ventilating system, and it is of a pocket size, for instant reference in checking up the size of main trunk ducts, branches or elbows; data on power, weights of material, and hoods for wood-working machinery in connection with dust and shaving collecting systems.

To the estimator, the tables of weights of round and rectangular ducts and elbows will prove a valuable addition where accuracy and time in figuring up each size of duct on a large contract is considered.

These tables have proven most efficient to the author in his work along these lines.

THE PUBLISHER.

Figuring Material

TO find the amount of iron required for any size pipe, turn the small dial so that the slot is opposite the diameter at the outer edge of the large disc, and read the circumference under "CIR.," which includes all laps according to size as noted. (To use a wider lap, add the difference between that given and the one to be used.)

All calculations are figured to the nearest 1/16 of an inch, so that all fractional parts on the celluloid charts (15:8) should be read as sixteenths of an inch; for example, 15.8 would read 15½".

Example: Required for circumference of a pipe 12" in diameter: Turn the dial to figure 12 and read under "CIR." 38.11 or 38 11/16", mark this measurement off on the iron for the large end, and deduct for the small end according to the gauge of iron used. (Fig. 1.) For tapering joints, draw a center line and mark off one-half of the circumference on each side, the large diameter at one end, the small diameter at the other. (Fig. 2.) To find the circumference of pipes of odd sizes such as that of a pipe 15½" in diameter, take the difference between the even inch given and the next largest size, as 16 inches in this case, and add half of this difference to the circumference of the even inch. Thus a 15½" diameter has a circumference of $48.2 + \frac{1}{2}(51.4 - 48.2) = 49\ 11/16$.

Area

TO find the area of any size of pipe, turn the dial to the diameter on the outer edge and read under "Area." To compute the area of a pipe which will equal the combined area of two or more

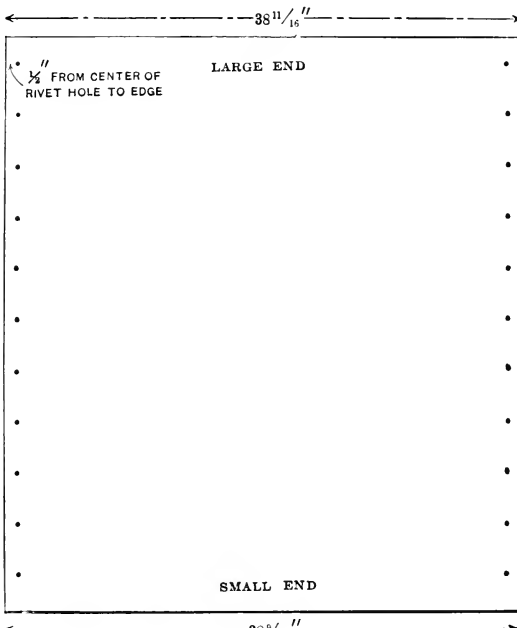


FIG. 1. PATTERN FOR 12" PIPE OF NO. 20 GAUGE

pipes, add the area of all the branches together, then turn the dial until the nearest number to the total

appears under "Area." At the outside read the required diameter.

For example: What size pipe would be required to equal the combined area of an 8", 12" and 16" pipe?

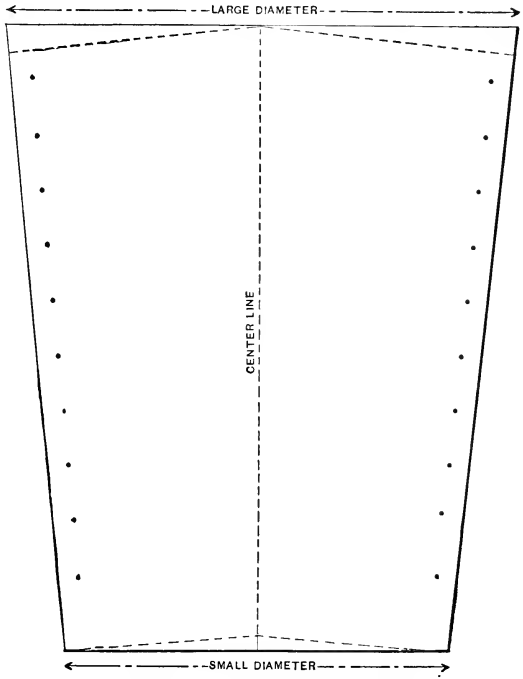


FIG. 2. TAPERING JOINT

Area 8"	50"
Area 12"	113"
Area 16"	201"
Total	364"

The nearest number given in the area table is 380, which is that of a 22″ diameter pipe.

To find the area of a trunk line from which a branch has been taken, deduct the area of the branch from the main trunk area and turn dial to the nearest number under "Area," and read the diameter of the continued trunk at the outer edge.

To find the diameter of a round pipe equal to a square or rectangular pipe, multiply the width by the depth and find nearest number under "Area," the outer edge of which will be the required diameter.

Elbows

THE calculations are based on 90 degree elbows, and all pieces have the same length of throat. ⅜-inch has been allowed for the seams. If elbow is to be riveted instead of peaned, add ⅝ of an inch to the measurements given. The radius means the distance from the center of a circle around which the inside of the elbow would fit. The usual method is to make the radius equal to the diameter of the pipe. With this chart, any radius from 3″ to 62″ can be used.

The number of pieces to be used in an elbow should be determined by its size and position. The greater the number of elbow pieces the less will be the friction of air in the pipe. The chart gives calculations for four, five and six pieces. For elbows with more pieces, use the following table:

How to make Elbows of 8 and more Pieces

For 8 piece elbow, take ½ measurement for 4 piece.
For 10 piece elbow, take ½ measurement for 5 piece.
For 12 piece elbow, take ½ measurement for 6 piece.
For 15 piece elbow, take 1/3 measurement for 5 piece.
For 18 piece elbow, take 1/3 measurement for 6 piece.
For 16 piece elbow, take ¼ measurement for 4 piece.
For 20 piece elbow, take ¼ measurement for 5 piece.
For 24 piece elbow, take ¼ measurement for 6 piece.

To each measurement, add ⅜ of an inch for the extra seam required.

Elbows of Less than 90 Degrees

For elbows less than 90°, use the following table.

DEGREES	PIECES	SECTIONS
27°	6	2
33° 75′	5	2
45°	6	3
56° 25′	5	3
63°	6	4
67° 50′	3	2
75°	4	3
78° 75′	5	4
81°	6	5

Explanation: If an elbow of 63° is required, use four sections of six piece of the same radius.

Figuring Rise for Elbow

The mitre line table gives the rise for all elbows above mentioned, measuring from the end of a level line 12″ long on a line at right angles to it. A diagonal line from the height of the rise to the other end of the 12″ level line will be the required mitre line. (Fig. 3.)

Rise for 4 piece elbow.....	3 7/32
Rise for 5 piece elbow.....	2 3/8
Rise for 6 piece elbow.....	1 7/8
Rise for 8 piece elbow.....	1 3/8
Rise for 10 piece elbow.....	1
Rise for 12 piece elbow.....	13/16
Rise for 15 piece elbow.....	19/32
Rise for 16 piece elbow.....	1/2
Rise for 18 piece elbow.....	15/32
Rise for 20 piece elbow.....	14/32
Rise for 24 piece elbow.....	27/64

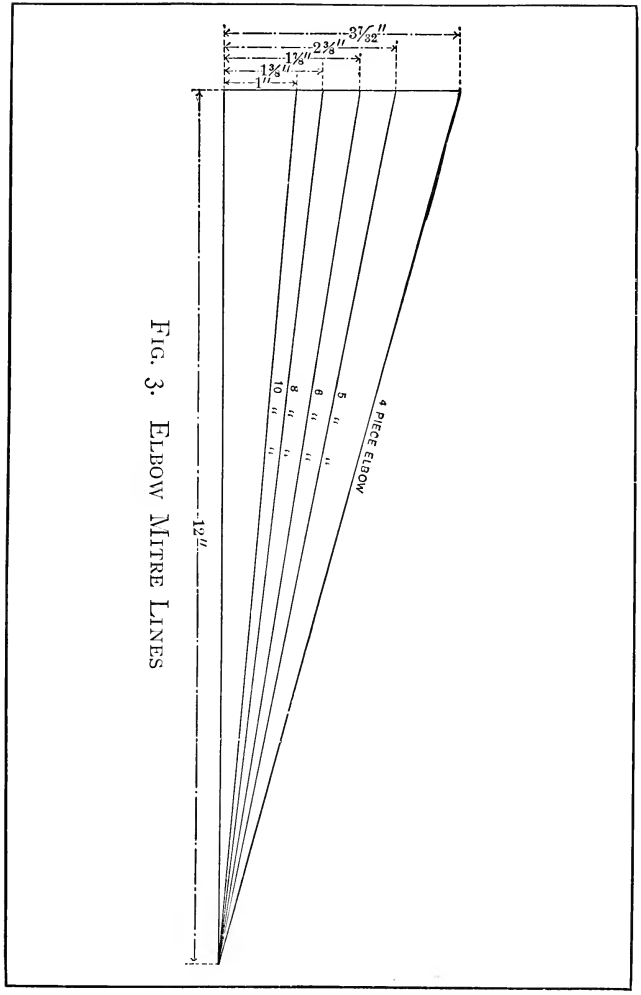


FIG. 3. ELBOW MITRE LINES

Example: Required, an elbow of 6 pieces, 90 degrees, 12″ in diameter and with a 12″ radius of 20

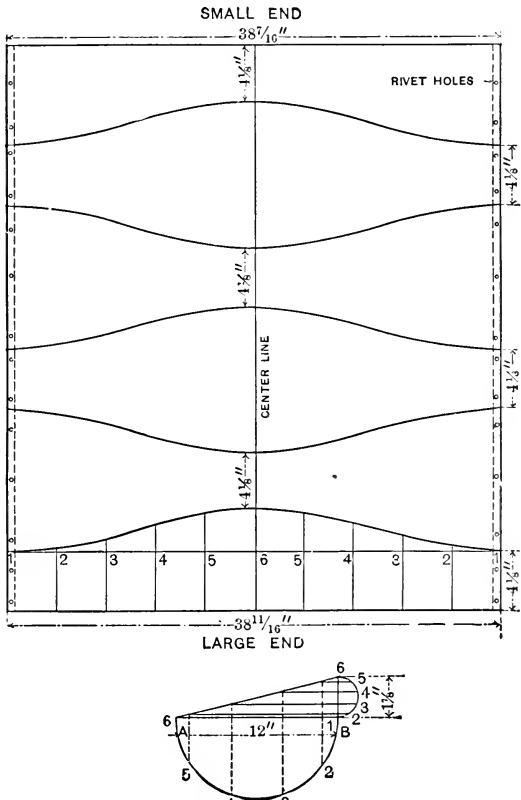


FIG. 4. LAYING OUT FROM CHART

gauge iron. First draw, as in Fig. 4, a level line 12″ long at the end of which draw a perpendicular line

1⅞″ long, as given in the table; from the end of this line, draw a diagonal line to the other end of the level line, continuing this line upward indefinitely, if the elbow is of a larger diameter. Draw a half circle equal to the diameter of the pipe below the level line, using the center of the level line as a radius point, or drawing a half circle equal to the rise at the end of the mitre line, as shown, making the distance from A to B equal to the diameter of the elbow. Divide either of these circles into any number of equal parts, numbering them as shown. From these points, draw lines to the mitre line. It will be noticed that both of these methods give the same result with respect to the intersection of the mitre line. Now lay off on a piece of iron a line equal to the circumference of a 12″ pipe, or 38 11/16, also marking a center point and draw line through these points indefinitely. Mark off the distance for the length of throat, as given in the table, 4⅛″ on both sides, and draw a line connecting these points. Space this line into twice as many spaces as the half circle was spaced, numbering these as shown; then draw lines from these points, as shown. Next, transfer the distance from the level line to the points of intersection on the mitre line to the corresponding numbered lines of the pattern, and a line traced through these points will give the correct cut. By cutting this pattern and using it as a template, the other patterns can be marked out very quickly, care being taken to keep the throat measurement 4⅛″, as shown. Rivet holes can be marked and punched before the elbow is cut; also the deduction for the small end should be made, as, in this case, 17/64 of an inch.

The reason for laying out the circumference from the chart instead of using the spacing of the half circle is, that the pipe would be made according to the chart, while the stretchout of the spacing would vary, and not coincide with the chart.

Round Galvanized Pipe

Weight per Lineal Foot

Diameter	Gauge				Diameter	Gauge			
	26	24	22	20		26	24	22	20
1	.312	.398	.485	.571	34	8.139	10.385	12.631	14.877
2	.549	.701	.852	1.004	35	8.376	10.687	12.998	15.311
3	.786	1.003	1.220	1.437	36	8.613	10.989	13.366	15.745
4	1.023	1.306	1.588	1.871	37	8.850	11.291	13.734	16.179
5	1.260	1.608	1.956	2.304	38	9.087	11.593	14.102	16.613
6	1.497	1.911	2.324	2.837	39	9.325	11.895	14.470	17.047
7	1.735	2.214	2.693	3.172	40	9.562	12.197	14.838	17.481
8	1.973	2.527	3.061	3.605	41	9.799	12.499	15.206	17.915
9	2.209	2.819	3.429	4.039	42	10.036	12.801	15.574	18.349
10	2.446	3.122	3.797	4.472	43	10.273	13.103	15.942	18.783
11	2.684	3.424	4.165	4.905	44	10.510	13.405	16.310	19.217
12	2.921	3.727	4.552	5.339	45	10.747	13.707	16.678	19.651
13	3.158	4.030	4.901	5.773	46	10.984	14.009	17.046	20.085
14	3.395	4.332	5.268	6.207	47	11.221	14.311	17.414	20.519
15	3.633	4.635	5.637	6.640	48	11.459	14.613	17.782	20.953
16	3.870	4.937	6.005	7.073	49	11.697	14.915	18.150	21.387
17	4.107	5.229	6.373	7.507	50	11.934	15.217	18.518	21.821
18	4.344	5.542	6.741	7.940	51	12.171	15.519	18.886	22.255
19	4.581	5.846	7.110	8.375	52	12.408	15.821	19.254	22.689
20	4.818	6.116	7.480	8.808	53	12.645	16.123	19.622	23.123
21	5.055	6.451	7.816	9.241	54	12.883	16.425	19.990	23.557
22	5.292	6.753	8.214	9.675	55	13.120	16.727	20.358	23.991
23	5.529	7.056	8.581	10.108	56	13.357	17.029	20.726	24.425
24	5.766	7.358	8.959	10.541	57	13.594	17.331	21.084	24.859
25	6.003	7.660	9.317	10.975	58	13.831	17.633	21.462	25.293
26	6.340	7.963	9.685	11.409	59	14.068	17.935	21.830	25.727
27	6.577	8.264	10.054	11.843	60	14.305	18.237	22.198	26.161
28	6.814	8.566	10.422	12.276	61	14.502	18.539	22.566	26.595
29	7.051	8.868	10.780	12.709	62	14.779	18.841	22.934	27.029
30	7.288	9.171	11.158	13.143	63	15.016	19.143	23.302	27.463
31	7.525	9.473	11.526	13.576	64	15.253	19.445	23.670	27.897
32	7.762	9.775	11.895	14.011	65	15.490	19.747	24.038	28.331
33	7.999	10.078	12.263	14.444	66	15.727	20.049	24.406	28.765

Weights of Elbows and Ducts

ADD one-half the diameter of the elbow to the radius and find the length of throat required for this size of elbow, which will represent the length of a line through the center of the elbow; multiply the length by the number of pieces in the elbow, which will give the length equal to a straight pipe, and find the weight per lineal foot in the pipe table.

Example: Required, the weight of a 6-piece elbow, 12″ diameter, 12″ radius, No. 20 gauge iron: $6 + 12 = 18$. Length of throat for an 18 inch radius elbow is 6.1. Then, $6.1 \times 6 = 36.6$ in.— 3.3/8 ft., at 5.339 (weight of one foot 12″ No. 20 pipe) lb. per foot of length, the elbow weighs 16 lb.

Black and Galvanized Sheets

Weight per Square Foot			
Number U. S. Standard Gauge	Thickness	Weight of Galvanized Iron	Weight of Black Iron
10	9-64	5.781	5.625
11	1-8	5.156	5.00
12	7-64	4.531	4.375
13	3-32	3.906	3.75
14	5-64	3.281	3.125
15	9-128	2.969	2.8125
16	1-16	2.656	2.5
17	9-160	2.406	2.25
18	1-20	2.156	2.0
19	7-160	1.906	1.75
20	3-80	1.656	1.50
21	11-320	1.531	1.375
22	1-32	1.406	1.25
23	9-360	1.281	1.125
24	1-40	1.156	1.00
25	7-320	1.031	.875
26	3-160	.9062	.75
27	11-640	.8437	.6875
28	1-64	.7812	.625

Galvanized Iron Ducts

Weight per Lineal Foot

EXPLANATION:—Find the sum of the four sides; refer to the table for the corresponding number in inches column; to the right will be found the weight.
EXAMPLE:—Find the weight of duct 26"×56" of No. 24 gauge. 26"+26"+56"+56"=164". 164"=17.32 lbs.

Inches	Gauge			Inches	Gauge		
	26	24	22		26	24	22
2	.25	.28	.35	102	8.00	10.21	12.36
4	.38	.48	.59	104	8.15	10.41	12.60
6	.53	.67	.83	106	8.30	10.61	12.87
8	.68	.86	1.07	108	8.45	10.81	13.11
10	.83	1.06	1.31	110	8.60	11.00	13.35
12	.98	1.26	1.55	112	8.75	11.20	13.59
14	1.13	1.48	1.79	114	8.90	11.40	13.83
16	1.28	1.64	2.02	116	9.05	11.50	14.07
18	1.43	1.85	2.26	118	9.20	11.72	14.31
20	1.59	2.03	2.50	120	9.36	11.90	14.55
22	1.74	2.22	2.73	122	9.51	12.10	14.78
24	1.89	2.41	2.97	124	9.66	12.27	15.02
26	2.04	2.61	3.21	126	9.81	12.47	15.26
28	2.19	2.80	3.45	128	9.96	12.65	15.50
30	2.34	2.99	3.69	130	10.11	12.85	15.74
32	2.49	3.18	3.92	132	10.26	13.00	15.98
34	2.64	3.37	4.21	134	10.41	13.20	16.21
36	2.79	3.66	4.45	136	10.56	13.40	16.45
38	2.94	3.86	4.69	138	10.71	13.68	16.69
40	3.10	4.05	4.92	140	10.87	13.86	16.92
42	3.25	4.24	5.16	142	11.85	15.12	18.37
44	3.40	4.43	5.40	144	12.00	15.32	18.61
46	3.55	4.63	5.64	146	12.15	15.52	18.85
48	3.70	4.82	5.88	148	12.30	15.72	19.09
50	3.85	5.01	6.12	150	12.45	15.92	19.32
52	4.00	5.21	6.35	152	12.60	16.12	19.56
54	4.15	5.40	6.59	154	12.75	16.32	19.80
56	4.30	5.59	6.83	156	12.90	16.52	20.04
58	4.45	5.78	7.07	158	13.06	16.72	20.28
60	4.60	5.97	7.31	160	13.21	16.92	20.51
62	4.75	6.17	7.55	162	13.36	17.12	20.75
64	4.90	6.36	7.79	164	13.51	17.32	20.99
66	5.05	6.55	8.02	166	13.89	17.71	21.52
68	5.21	6.75	8.30	168	14.04	17.91	21.76
70	5.51	6.93	8.54	170	14.19	18.11	22.00
72	5.66	7.03	8.78	172	14.34	18.31	22.24
74	5.81	7.23	9.02	174	14.49	18.51	22.48
76	5.96	7.43	9.26	176	14.64	18.71	22.72
78	6.11	7.62	9.50	178	14.79	18.91	22.96
80	6.26	7.82	9.73	180	14.94	19.11	23.20
82	6.41	8.12	9.97	182	15.10	19.31	23.43
84	6.56	8.31	10.21	184	15.25	19.51	23.67
86	6.71	8.51	10.45	186	15.40	19.75	23.90
88	6.86	8.70	10.69	188	15.55	19.90	24.15
90	7.01	8.90	10.93	190	15.70	20.09	24.39
92	7.16	9.10	11.17	192	15.85	20.29	24.62
94	7.31	9.30	11.41	194	16.00	20.48	24.86
96	7.46	9.50	11.63	196	16.15	20.67	25.10
98	7.61	9.70	11.89	198	16.30	20.86	25.34
100	7.84	10.01	12.12	200	16.68	21.28	25.85

NOTE:—1" lap is allowed for joints up to 140", 3" lap for all others.

Galvanized Iron Ducts

Weight per Lineal Foot

Inches	Gauge			Inches	Gauge		
	24	22	20		24	22	20
202	21.57	26.14	30.7	302	31.9	38.9	45.8
204	21.66	26.38	31.0	304	32.1	39.2	46.0
206	21.86	26.62	31.3	306	32.3	39.4	46.2
208	22.05	26.86	31.6	308	32.5	39.6	46.6
210	22.24	27.10	31.8	310	32.7	39.9	46.9
212	22.43	27.34	32.1	312	32.9	40.1	47.1
214	22.63	27.58	32.4	314	33.1	40.4	47.4
216	22.82	27.82	32.7	316	33.3	40.6	47.7
218	23.01	28.06	33.0	318	33.5	40.8	48.0
220	23.20	28.30	33.2	320	33.7	41.1	48.3
222	23.40	28.54	33.5	322	33.9	41.3	48.6
224	23.66	28.78	33.8	324	34.1	41.6	48.9
226	23.80	29.02	34.1	326	34.3	41.8	49.1
228	24.00	29.26	34.4	328	34.5	42.0	49.4
230	24.26	29.50	34.7	330	34.7	42.3	49.7
232	24.40	29.74	35.3	332	35.1	42.5	50.2
234	24.80	30.00	35.6	334	35.3	43.0	50.5
236	25.04	30.24	35.9	336	35.5	43.2	50.7
238	25.24	30.48	36.2	338	35.7	43.5	51.0
240	25.44	30.72	36.5	340	35.9	43.7	51.3
242	25.64	30.96	36.8	342	36.1	44.0	51.6
244	25.84	31.20	37.1	344	36.3	44.2	51.9
246	26.05	31.44	37.4	346	36.5	44.5	52.1
248	26.25	31.68	37.7	348	36.7	44.7	52.4
250	26.45	31.92	38.0	350	36.8	44.9	52.7
252	26.65	32.11	38.3	352	37.1	45.2	53.0
254	26.85	32.40	38.6	354	37.3	45.4	53.2
256	27.06	32.64	38.9	356	37.5	45.7	53.5
258	27.26	32.88	39.2	358	37.7	45.9	53.8
260	27.46	33.12	39.5	360	37.9	46.1	54.1
262	27.66	33.36	39.8	362	38.1	46.4	54.4
264	28.02	33.60	40.1	364	38.5	46.9	55.2
266	28.22	34.22	40.4	366	38.7	47.1	55.5
268	28.42	34.46	40.8	368	38.9	47.4	55.7
270	28.62	34.70	41.0	370	39.1	47.6	56.0
272	28.82	34.94	41.3	372	39.3	47.8	56.3
274	29.02	35.18	41.6	374	39.5	48.1	56.6
276	29.23	35.43	41.9	376	39.7	48.3	56.9
278	29.43	35.66	42.2	378	39.9	48.6	57.2
280	29.63	35.90	42.5	380	40.1	48.8	57.4
282	29.83	36.14	42.8	382	40.3	49.1	57.7
284	30.04	36.38	43.0	384	40.5	49.3	58.0
286	30.24	36.62	43.3	386	40.7	49.5	58.3
288	30.44	36.86	43.6	388	40.9	49.8	58.6
290	30.64	37.10	43.9	390	41.1	50.0	58.9
292	30.84	37.34	44.1	392	41.3	50.2	59.2
294	31.05	37.58	44.4	394	41.5	50.5	59.4
296	31.25	37.82	44.6	396	41.7	51.0	59.7
298	31.49	38.44	45.2	398	41.9	51.2	60.3
300	31.69	38.68	45.5	400	42.1	51.5	60.6

NOTE:—1" lap is allowed for joints up to 140", 3" lap for all others.

Galvanized Iron Ducts

Weight per Lineal Foot

Inches	Gauge			Inches	Gauge		
	22	20	18		22	20	18
402	51.7	60.9	79.2	452	57.9	68.0	88.7
404	51.9	61.2	79.5	454	58.1	68.3	89.0
406	52.1	61.4	79.9	456	58.4	68.6	89.4
408	52.4	61.2	80.2	458	58.6	68.9	89.8
410	52.6	62.0	80.6	460	58.9	69.2	90.1
412	52.9	62.3	81.0	462	59.1	69.4	90.5
414	53.1	62.6	81.3	464	59.6	69.7	91.4
416	53.3	62.8	81.7	466	59.8	70.2	91.7
418	53.6	63.1	82.0	468	60.1	70.5	92.1
420	53.8	63.4	82.4	470	60.3	70.8	92.5
422	54.1	63.7	82.8	472	60.6	71.0	92.8
424	54.3	64.0	83.1	474	60.8	71.3	93.2
426	54.5	64.3	83.4	476	61.0	71.6	93.5
428	54.8	64.6	83.8	478	61.3	71.9	93.9
430	55.3	64.9	84.7	480	61.5	72.2	94.3
432	55.5	65.3	85.1	482	61.8	72.4	94.6
434	55.7	65.6	85.4	484	62.0	72.7	95.0
436	56.0	65.8	85.8	486	62.2	73.0	95.3
438	56.2	66.1	86.2	488	62.5	73.3	95.7
440	56.5	66.4	86.5	490	62.7	73.6	96.1
442	56.7	66.6	86.9	492	63.0	73.9	96.4
444	56.9	66.9	87.2	494	63.2	74.2	96.8
446	57.2	67.2	87.6	496	63.4	74.5	97.1
448	57.4	67.5	88.0	498	64.0	74.8	98.0
450	57.7	67.9	88.3	500	64.3	75.0	98.4

Size of Conductor Pipes

3½ in. Through, up to 12 ft. long; use 2-in. Conductor Pipe
3½ in. Through, 12 to 25 ft. long; use 3-in. Conductor Pipe
4 in. Through, 25 to 35 ft. long; use 3-in. Conductor Pipe
5 in. Through, 35 to 45 ft. long; use 4-in. Conductor Pipe
6 in. Through, 45 to 55 ft. long; use 5-in. Conductor Pipe
7 in. Through, 55 to 65 ft. long; use 6-in. Conductor Pipe
8 in. Through, 65 to 75 ft. long; use 7-in. Conductor Pipe

Revolutions of Fan Wheel of Given Diameter Necessary to Maintain a Given Pressure Over an Area Which is Within the Capacity of the Fan

Diameter of Fan Wheel, in Feet	Pressure, in Ounces per Square Inch												
	⅛	¼	⅜	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1¾
1	582	823	1,007	1,163	1,300	1,423	1,537	1,643	1,742	1,836	1,925	2,010	2,170
1¼	466	658	806	930	1,040	1,139	1,230	1,314	1,394	1,469	1,540	1,608	1,736
1½	388	549	672	775	867	949	1,025	1,095	1,162	1,224	1,284	1,340	1,447
1¾	333	470	576	665	743	813	878	938	996	1,049	1,100	1,149	1,240
2	291	411	504	582	650	712	769	822	871	918	963	1,005	1,085
2¼	259	366	448	517	578	633	683	730	774	816	856	893	964
2½	233	329	403	465	520	570	615	657	697	734	770	804	868
2¾	212	300	366	423	473	518	559	597	634	668	700	731	789
3	194	274	335	388	433	475	513	548	581	612	642	670	723
3½	166	235	288	332	372	407	439	469	498	525	550	574	620
4	146	206	252	291	325	356	384	411	436	459	481	502	543
4½	129	183	224	258	289	316	342	365	387	408	428	447	482
5	116	164	202	232	260	285	308	329	349	367	385	402	434
5½	103	149	183	211	236	259	280	299	317	334	350	366	395
6	97	137	168	194	217	238	256	274	290	306	321	335	362
6½	90	126	155	179	200	219	236	253	268	282	296	309	334
7	83	117	144	166	186	203	220	235	249	262	275	287	310
7½	78	110	135	155	173	190	204	219	232	245	257	268	289
8	73	103	126	146	163	178	192	205	218	230	241	251	271
8½	69	97	119	137	153	167	181	194	205	216	226	236	255
9	65	92	112	129	144	158	171	183	194	204	214	223	241
9½	61	87	106	123	137	149	162	173	183	193	203	212	228
10	58	82	101	116	130	142	154	164	174	184	193	201	217
11	53	75	92	106	118	129	140	150	158	167	175	183	197
12	49	69	84	97	108	119	128	137	145	153	160	168	181
13	45	63	78	90	100	110	116	126	130	141	148	155	167
14	42	59	72	83	93	102	110	117	124	131	138	144	155
15	39	55	67	78	87	95	102	110	116	122	128	134	145

Flue Area Required for the Passage of a Given Volume of Air at a Given Velocity

Volume in Cubic Feet per Minute	VELOCITY IN FEET PER MINUTE													
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600
100	48	36	29	24	21	18	16	14	13	12	11	10	9.6	9.0
125	60	45	36	30	26	23	20	18	16	15	14	13	12.0	11.3
150	72	54	43	36	31	27	24	22	20	18	16	15	14.4	13.5
175	84	63	50	42	36	32	28	25	23	21	19	18	16.8	15.8
200	96	72	58	48	41	36	32	29	26	24	22	21	19.2	18.0
225	108	81	65	54	46	41	36	32	29	27	25	23	21.6	20.3
250	120	90	72	60	51	45	40	36	33	30	28	26	24.0	22.5
275	132	99	79	66	57	50	44	40	36	33	30	28	26.4	24.8
300	144	108	86	72	62	54	48	43	39	36	33	31	28.8	27.0
325	156	117	94	78	67	59	52	47	43	39	36	33	31.2	29.3
350	168	126	101	84	72	63	56	50	46	42	39	36	33.6	31.5
375	180	135	108	90	77	68	60	54	49	45	42	39	36.0	33.8
400	192	144	115	96	82	72	64	58	52	48	44	41	38.4	36.0
425	204	153	122	102	87	77	68	61	56	51	47	44	40.8	38.3
450	216	162	130	108	93	81	72	65	59	54	50	46	43.2	40.5
475	228	171	137	114	98	86	76	68	62	57	53	49	45.6	42.8
500	240	180	144	120	103	90	80	72	65	60	55	51	48.0	45.0
525	252	189	151	126	108	95	84	76	69	63	58	54	50.4	47.3
550	264	198	158	132	113	99	88	79	72	66	61	57	52.8	49.5
575	276	207	166	138	118	104	92	83	75	69	64	59	55.2	51.8
600	288	216	173	144	123	108	96	86	79	72	66	62	57.6	54.0
625	300	225	180	150	129	113	100	90	82	75	69	64	60.0	56.3
650	312	234	187	156	134	117	104	94	85	78	72	67	62.4	58.5
675	324	243	194	162	139	122	108	97	88	81	75	69	64.8	60.8
700	336	252	202	168	144	126	112	101	92	84	78	72	67.2	63.0
725	348	261	209	174	149	131	116	104	95	87	80	75	69.6	65.3
750	360	270	216	180	154	135	120	108	98	90	83	77	72.0	67.5
775	372	279	223	186	159	140	124	112	101	93	86	80	74.4	69.8
800	384	288	230	192	165	144	128	115	105	96	89	82	76.8	72.0
825	396	297	238	198	170	149	132	119	108	99	91	85	79.2	74.3
850	408	306	245	204	175	153	136	122	111	102	94	87	81.6	76.5
875	420	315	252	210	180	158	140	126	115	105	97	90	84.0	78.8
900	432	324	259	216	185	162	144	130	118	108	100	93	86.4	81.0
925	444	333	266	222	190	167	148	133	121	111	103	95	88.8	83.3
950	456	342	274	228	195	171	152	137	124	114	105	98	91.2	85.5
975	468	351	281	234	201	176	156	140	128	117	108	100	93.6	87.8
1000	480	360	288	240	206	180	160	144	131	120	111	103	96.0	90.0

Flue Area Required for the Passage of a Given Volume of Air at a Given Velocity

Volume in Cubic Feet per Minute	VELOCITY IN FEET PER MINUTE													
	1700	1800	1900	2000	2100	2200	2300	2400	2600	2700	2800	2900	3000	3100
100	8.5	8	7.6	7.2	6.9	6.6	6.3	6.0	5.5	5.3	5.1	5.0	4.8	4.6
125	10.6	10	9.5	9.0	8.6	8.2	7.8	7.5	6.9	6.7	6.4	6.2	6.0	5.8
150	12.7	12	11.4	10.8	10.3	9.8	9.4	9.0	8.0	8.0	7.7	7.5	7.2	7.0
175	14.8	14	13.3	12.6	12.0	11.5	11.0	10.5	9.7	9.3	9.0	8.7	8.4	8.1
200	16.9	16	15.2	14.4	13.7	13.1	12.5	12.0	11.1	10.7	10.3	9.9	9.6	9.3
225	19.1	18	17.1	16.2	15.6	14.7	14.1	13.5	12.5	12.0	11.6	11.2	10.8	10.4
250	21.2	20	19.0	18.0	17.1	16.4	15.7	15.0	13.9	13.3	12.9	12.4	12.0	11.6
275	23.3	22	21.8	19.8	18.9	18.0	17.2	16.5	15.2	14.7	14.1	13.7	13.2	12.8
300	25.4	24	22.7	21.6	20.6	19.6	18.8	18.0	16.6	16.0	15.4	14.9	14.4	13.9
325	27.5	26	24.6	23.4	22.3	21.3	20.6	19.5	18.0	17.3	16.7	16.1	15.6	15.1
350	29.6	28	26.5	25.2	24.0	22.9	21.9	21.0	19.4	18.7	18.0	17.4	16.8	16.3
375	31.8	30	28.4	27.0	25.7	24.5	23.5	22.5	20.8	20.0	19.3	18.6	18.0	17.4
400	33.9	32	30.3	28.8	27.4	26.2	25.0	24.0	22.2	21.3	20.6	19.8	19.2	18.6
425	36.0	34	32.2	30.6	29.1	27.8	26.6	25.5	23.5	22.7	21.9	21.1	20.4	19.7
450	38.1	36	34.1	32.4	30.9	29.5	28.2	27.0	24.9	24.0	23.1	22.3	21.6	20.9
475	40.2	38	36.0	34.2	32.6	31.1	29.7	28.5	26.3	25.3	24.4	23.6	22.8	22.1
500	42.4	40	37.9	36.0	34.3	32.7	31.3	30.0	27.7	26.7	25.7	24.8	24.0	23.2
525	44.5	42	39.8	37.8	36.0	34.4	32.9	31.5	29.1	28.0	26.9	25.0	25.2	24.4
550	46.6	44	41.7	38.6	37.7	36.0	34.4	33.0	30.5	29.3	28.3	27.3	26.4	25.5
575	48.7	46	43.6	41.4	39.4	37.6	36.0	34.5	31.9	30.7	29.6	28.5	27.6	26.7
600	50.8	48	45.5	43.2	41.1	39.3	37.6	36.0	33.2	32.0	30.8	29.8	28.8	27.8
625	52.9	50	47.4	45.0	42.9	40.9	39.1	37.5	34.6	33.3	32.1	31.0	30.0	29.0
650	55.1	52	49.3	46.8	44.6	42.5	40.7	39.0	36.0	34.7	33.4	32.2	31.2	30.2
675	57.2	54	51.2	48.6	46.3	44.1	42.3	40.5	37.5	36.0	34.7	33.5	32.4	31.3
700	59.3	56	53.1	50.4	48.0	45.8	43.6	42.0	38.8	37.3	36.0	34.7	33.6	32.5
725	61.4	58	55.0	52.2	49.7	47.4	45.4	43.5	40.2	38.7	37.3	36.0	34.8	33.6
750	63.5	60	56.9	54.0	51.4	49.1	47.0	45.0	41.5	40.0	38.6	37.2	36.0	34.8
775	65.6	62	58.8	56.3	53.1	50.7	48.5	46.5	42.9	41.3	39.9	38.5	37.2	36.0
800	67.8	64	60.6	57.6	54.9	52.4	50.1	48.0	44.3	42.7	41.2	39.7	38.4	37.1
825	69.9	66	62.5	59.4	56.6	54.0	51.7	49.5	45.7	44.0	42.4	40.9	39.6	38.3
850	72.0	68	64.4	61.2	58.4	55.6	53.2	51.0	47.1	45.3	43.7	42.2	40.8	39.4
875	74.0	70	67.3	63.0	60.0	57.3	54.8	52.5	48.5	46.7	45.0	43.4	42.0	40.6
900	76.2	72	68.2	64.8	61.7	58.9	56.3	54.0	49.9	48.0	46.3	44.6	43.2	41.8
925	78.4	74	70.1	66.6	63.4	60.5	57.9	55.5	51.3	49.3	47.6	46.0	44.4	42.9
950	80.5	76	72.0	68.4	65.1	62.2	59.5	57.0	52.6	50.7	48.8	47.1	45.6	44.1
975	82.6	78	73.9	70.2	66.8	63.8	61.0	58.5	54.0	52.0	50.2	48.4	46.8	45.3
1000	84.7	80	75.8	72.0	68.7	66.0	62.6	60.0	55.4	53.3	51.4	49.6	48.0	46.4

Number of Square Inches of Flue Area Required per 1,000 *Cubic Feet of Contents for Given Velocity and Air Change*

No. Minutes to Change Air	Velocity of Air in Flue in Feet per Minute												
	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500
4	120.0	90.0	72.0	60.0	51.6	45.0	40.0	36.0	32.2	30.0	27.6	25.6	21.4
5	96.0	72.2	57.6	48.0	41.1	36.1	32.0	28.8	26.2	24.0	22.2	20.5	19.2
6	80.0	60.0	48.0	40.0	34.3	30.0	26.6	24.0	21.8	20.0	18.5	17.1	16.0
7	68.6	51.4	41.1	34.3	29.4	25.7	22.9	20.6	18.7	17.2	15.7	14.7	13.7
8	60.0	45.0	36.0	30.0	25.8	22.5	20.0	18.0	16.1	15.0	13.8	12.8	12.0
9	53.3	40 0	32.0	26.6	22.9	20.0	17.8	16.0	14.5	13.3	12.3	11.4	10.7
10	48.0	36.0	28.8	24.0	20.6	18.9	16.0	14.4	13.1	12.0	11.1	10.3	9.6
11	43.6	32.2	26.2	21.8	18.7	16.1	14.5	13.1	11.9	10.9	10.1	9.5	8.7
12	40.0	30.0	24.0	20.0	17.2	15.0	13.3	12.0	10.9	10.0	9.2	8.6	8.0
13	36.9	27.7	22.2	18.5	15.7	13.8	12.3	11.1	10.1	9.2	8.5	7.9	7.4
14	34.3	25.7	20.6	17.2	14.7	12.8	11.4	10.3	9.5	8.6	7.9	7.4	6.9
15	32.0	24.0	19.2	16.0	13.7	12.0	10.7	9.6	8.7	8.0	7.4	6.9	6.4
16	30.0	22.5	18.0	15.0	12.9	11.2	10.0	9.0	8.2	7.5	6.9	6.4	6.0
17	28.2	21.2	16.9	14.1	12.1	10.6	9.4	8.5	7.7	7.0	6.5	6.1	5.6
18	26.6	20.0	16.0	13.3	11.5	10.0	8.9	8.0	7.3	6.6	6.2	5.7	5.3
19	25.3	18.9	15.2	12.6	10.8	9.5	8.4	7.6	6.9	6.3	5.8	5.4	5.1
20	24.0	18.0	14.4	12.0	10.3	9.9	8.0	7.2	6.5	6.0	5.5	5.1	4.8

To facilitate calculation of flue areas for different requirements in heating, ventilation and the general movement of air, the table above and that upon the two succeeding pages have been prepared. The former is to be employed when in a ventilating system the area of the flue is to be based upon the time required to change the air within the room and upon the permissible velocity in the flue. The latter table indicates the flue area necessary for the passage of a predetermined volume of air at stated velocity. Values for volumes below 100 or above 1,000 cubic feet may be readily determined from the latter table by reading for the multiple of the given volume, and then pointing off the requisite number of places. Thus, if a volume of 8,750 cubic feet of air is required to pass through a flue at a velocity of 900 feet per minute, the cross sectional area of that flue must be 1,400 square inches.

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes

Velocity of Air in Feet per Minute	DIAMETER OF PIPE									
	1-inch		2-inch		3 -inch		4-inch		5-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction
100	0.011	0.0000	0.006	0.0000	0.004	0.0000	0.003	0.0000	0.002	0.0000
200	0.044	0.0000	0.022	0.0000	0.015	0.0000	0.011	0.0001	0.009	0.0001
300	0.100	0.0000	0.050	0.0001	0.033	0.0001	0.025	0.0002	0.020	0.0002
400	0.178	0.0001	0.088	0.0002	0.059	0.0003	0.044	0.0004	0.036	0.0005
500	0.278	0.0002	0.139	0.0004	0.092	0.0006	0.069	0.0008	0.056	0.0010
600	0.400	0.0004	0.200	0.0007	0.133	0.0011	0.100	0.0014	0.080	0.0018
700	0.544	0.0006	0.272	0.0011	0.181	0.0017	0.138	0.0023	0.109	0.0028
800	0.711	0.0008	0.356	0.0017	0.237	0.0025	0.178	0.0034	0.142	0.0042
900	0.900	0.0012	0.450	0.0024	0.300	0.0036	0.225	0.0048	0.180	0.0060
1,000	1.111	0.0017	0.556	0.0033	0.370	0.0049	0.278	0.0066	0.222	0.0083
1,100	1.344	0.0022	0.672	0.0044	0.448	0.0066	0.338	0.0088	0.269	0.0110
1,200	1.600	0.0029	0.800	0.0057	0.533	0.0085	0.400	0.0114	0.320	0.0143
1,300	1.878	0.0036	0.939	0.0073	0.626	0.0109	0.469	0.0145	0.376	0.0182
1,400	2.178	0.0045	1.089	0.0090	0.726	0.0136	0.544	0.0181	0.436	0.0227
1,500	2.500	0.0056	1.250	0.0112	0.833	0.0167	0.625	0.0223	0.500	0.0279
1,600	2.844	0.0068	1.422	0.0135	0.948	0.0203	0.711	0.0271	0.569	0.0338
1,700	3.211	0.0081	1.605	0.0162	1.070	0.0244	0.803	0.0325	0.642	0.0405
1,800	3.600	0.0096	1.800	0.0192	1.200	0.0289	0.900	0.0385	0.720	0.0482
1,900	4.011	0.0113	2.006	0.0227	1.337	0.0340	1.003	0.0453	0.802	0.0567
2,000	4.444	0.0132	2.222	0.0264	1.481	0.0397	1.111	0.0529	0.889	0.0661
2,200	5.378	0.0176	2.689	0.0352	1.793	0.0528	1.344	0.0704	1.076	0.0880
2,400	6.400	0.0228	3.200	0.0457	2.133	0.0685	1.600	0.0914	1.280	0.1142
2,600	7.511	0.0290	3.756	0.0581	2.504	0.0871	1.877	0.1162	1.502	0.1452
2,800	8.711	0.0363	4.356	0.0726	2.904	0.1088	2.178	0.1451	1.742	0.1814
3,000	10.000	0.0446	5.000	0.0892	3.333	0.1339	2.500	0.1785	2.000	0.2231
3,200	11.378	0.0541	5.689	0.1083	3.792	0.1625	2.844	0.2166	2.276	0.2708
3,400	12.844	0.0649	6.422	0.1299	4.281	0.1949	3.211	0.2598	2.569	0.3247
3,600	14.400	0.0770	7.200	0.1542	4.800	0.2313	3.600	0.3084	2.880	0.3855
3,800	16.044	0.0906	8.022	0.1814	5.349	0.2720	4.011	0.3627	3.209	0.4534
4,000	17.778	0.1058	8.889	0.2115	5.926	0.3173	4.444	0.4230	3.556	0.5288
4,200	.....	.....	9.800	0.2448	6.553	0.3673	4.900	0.4897	3.920	0.6121
4,400	.....	.....	10.705	0.2815	7.175	0.4223	5.353	0.5631	4.282	0.7038
4,800	.....	.....	12.800	0.3655	8.533	0.5484	6.400	0.7310	5.120	0.9138
5,200	.....	.....	15.022	0.4747	10.015	0.6971	7.511	0.9294	6.008	1.1618
5,600	.....	.....	17.422	0.5804	11.615	0.8707	8.711	1.1608	6.969	1.4510
6,000	.....	.....	20.000	0.7139	13.333	1.0710	10.000	1.4278	8.000	1.7847

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes—Continued

Velocity of Air in Feet per Minute	DIAMETER OF PIPE									
	6-inch		7-inch		8-inch		9-inch		10-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction
100	0.002	0.0000	0.002	0.0000	0.001	0.0000	0.001	0.0000	0.001	0.0000
200	0.007	0.0001	0.005	0.0001	0.005	0.0001	0.005	0.0001	0.004	0.0001
300	0.017	0.0003	0.014	0.0003	0.012	0.0004	0.011	0.0004	0.010	0.0004
400	0.030	0.0006	0.025	0.0007	0.022	0.0008	0.020	0.0009	0.018	0.0011
500	0.045	0.0012	0.040	0.0014	0.035	0.0017	0.031	0.0019	0.028	0.0021
600	0.067	0.0021	0.057	0.0025	0.050	0.0029	0.044	0.0032	0.040	0.0036
700	0.091	0.0034	0.078	0.0040	0.068	0.0045	0.060	0.0051	0.054	0.0057
800	0.119	0.0051	0.102	0.0059	0.089	0.0067	0.079	0.0076	0.071	0.0085
900	0.150	0.0072	0.129	0.0084	0.112	0.0096	0.100	0.0108	0.090	0.0120
1,000	0.185	0.0099	0.159	0.0116	0.139	0.0132	0.123	0.0148	0.111	0.0165
1,100	0.224	0.0132	0.192	0.0154	0.168	0.0176	0.149	0.0198	0.134	0.0220
1,200	0.267	0.0171	0.229	0.0200	0.200	0.0230	0.178	0.0256	0.160	0.0283
1,300	0.313	0.0218	0.268	0.0254	0.235	0.0290	0.209	0.0327	0.188	0.0363
1,400	0.363	0.0272	0.311	0.0317	0.282	0.0363	0.242	0.0408	0.218	0.0453
1,500	0.417	0.0335	0.357	0.0390	0.312	0.0446	0.278	0.0502	0.250	0.0558
1,600	0.474	0.0406	0.406	0.0473	0.356	0.0541	0.316	0.0609	0.284	0.0677
1,700	0.535	0.0487	0.459	0.0568	0.401	0.0649	0.357	0.0731	0.321	0.0812
1,800	0.600	0.0578	0.514	0.0674	0.450	0.0771	0.400	0.0837	0.360	0.0964
1,900	0.669	0.0680	0.573	0.0793	0.501	0.0907	0.446	0.1020	0.401	0.1133
2,000	0.741	0.0793	0.635	0.0925	0.556	0.1058	0.493	0.1190	0.444	0.1322
2,200	0.896	0.1161	0.683	0.1232	0.672	0.1408	0.597	0.1583	0.538	0.1760
2,400	1.067	0.1371	0.914	0.1600	0.800	0.1728	0.711	0.2056	0.640	0.2284
2,600	1.252	0.1743	1.073	0.2033	0.939	0.2324	0.835	0.2614	0.751	0.2904
2,800	1.452	0.2177	1.244	0.2539	1.089	0.2902	0.968	0.3265	0.871	0.3628
3,000	1.667	0.2677	1.429	0.3123	1.250	0.3569	1.111	0.4016	1.000	0.4462
3,200	1.896	0.3249	1.625	0.3790	1.422	0.4332	1.263	0.4873	1.138	0.5415
3,400	2.141	0.3897	1.835	0.4546	1.606	0.5237	1.427	0.5845	1.284	0.6495
3,600	2.400	0.4626	2.057	0.5397	1.800	0.6168	1.600	0.7039	1.440	0.7710
3,800	2.674	0.5441	2.292	0.6347	2.006	0.7254	1.783	0.8171	1.604	0.9038
4,000	2.963	0.6346	2.540	0.7403	2.222	0.8461	1.975	0.9518	1.778	1.0576
4,200	3.267	0.7346	2.800	0.8570	2.450	0.9794	2.178	1.1019	1.960	1.2243
4,400	3.569	0.8446	3.059	0.9854	2.676	1.1261	2.379	1.2669	2.141	1.4077
4,800	4.267	1.0964	3.657	1.2793	3.200	1.4620	2.844	1.6448	2.560	1.8275
5,200	5.007	1.3941	4.292	1.6265	3.756	1.8588	3.339	2.0912	3.004	2.3236
5,600	5.807	1.7412	4.978	2.0314	4.356	2.3216	3.872	2.6118	3.484	2.9021
6,000	6.667	2.1416	5.714	2.4986	5.000	2.8555	4.444	3.2125	4.000	3.5694

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes—Continued

Velocity of Air in Feet per Minute	DIAMETER OF PIPE									
	28-inch		30-inch		32-inch		36-inch		40-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in	H. P. lost in Friction
100	0.000	0.0000	0.000	0.0001	0.000	0.0001	0.000	0.0001	0.000	0.0001
200	0.002	0.0004	0.001	0.0004	0.001	0.0004	0.001	0.0005	0.001	0.0005
300	0.004	0.0012	0.003	0.0014	0.003	0.0014	0.003	0.0016	0.002	0.0018
400	0.003	0.0030	0.006	0.0032	0.006	0.0034	0.005	0.0038	0.004	0.0042
500	0.010	0.0058	0.009	0.0062	0.009	0.0066	0.008	0.0074	0.007	0.0083
600	0.014	0.0100	0.013	0.0107	0.012	0.0114	0.011	0.0128	0.010	0.0143
700	0.019	0.0159	0.018	0.0170	0.017	0.0181	0.015	0.0204	0.014	0.0227
800	0.025	0.0237	0.024	0.0254	0.022	0.0271	0.020	0.0305	0.018	0.0339
900	0.032	0.0337	0.030	0.0361	0.028	0.0385	0.025	0.0434	0.022	0.0482
1,000	0.040	0.0463	0.037	0.0496	0.035	0.0530	0.031	0.0595	0.028	0.0661
1,100	0.048	0.0616	0.045	0.0660	0.042	0.0704	0.035	0.0792	0.034	0.0880
1,200	0.057	0.0800	0.053	0.0857	0.050	0.0914	0.044	0.1024	0.040	0.1142
1,300	0.067	0.1017	0.063	0.1089	0.058	0.1162	0.052	0.1307	0.047	0.1452
1,400	0.078	0.1270	0.073	0.1360	0.068	0.1451	0.060	0.1632	0.054	0.1814
1,500	0.089	0.1562	0.083	0.1673	0.078	0.1785	0.069	0.2008	0.062	0.2231
1,600	0.102	0.1895	0.095	0.2031	0.089	0.2166	0.079	0.2437	0.071	0.2707
1,700	0.115	0.2273	0.107	0.2436	0.103	0.2598	0.089	0.2923	0.080	0.3247
1,800	0.129	0.2702	0.120	0.2891	0.112	0.3084	0.100	0.3469	0.090	0.3855
1,900	0.143	0.3174	0.134	0.3401	0.125	0.3627	0.111	0.4080	0.103	0.4534
2,000	0.159	0.3702	0.148	0.3966	0.139	0.4230	0.123	0.4759	0.111	0.5288
2,200	0.192	0.4927	0.179	0.5279	0.168	0.5631	0.149	0.6334	0.134	0.7038
2,400	0.239	0.6396	0.213	0.6855	0.200	0.6910	0.178	0.8224	0.160	0.9138
2,600	0.268	0.8132	0.250	0.8714	0.234	0.9294	0.209	1.0456	0.188	1.1618
2,800	0.311	1.0157	0.290	1.0884	0.272	1.1608	0.242	1.3059	0.218	1.4510
3,000	0.357	1.2490	0.333	1.3388	0.312	1.4280	0.278	1.6062	0.250	1.7847
3,200	0.406	1.5162	0.379	1.6246	0.356	1.7328	0.316	1.9494	0.284	2.1660
3,400	0.459	1.8186	0.428	1.9487	0.413	2.0950	0.357	2.3382	0.321	2.5980
3,600	0.514	2.1620	0.480	2.3132	0.450	2.4671	0.400	2.8153	0.360	3.0840
3,800	0.573	2.5389	0.535	2.7206	0.501	2.9016	0.446	3.2683	0.401	3.6270
4,000	0.635	2.9613	0.593	3.1731	0.556	3.3843	0.494	3.8074	0.444	4.2304
4,200	0.700	3.4281	0.653	3.6729	0.612	3.9178	0.544	4.4075	0.490	4.8972
4,400	0.768	3.9415	0.717	4.2234	0.672	4.5045	0.595	5.0676	0.535	5.6307
4,800	0.914	5.1171	0.853	5.4836	0.800	5.8481	0.711	6.5791	0.640	7.3101
5,200	1.073	6.5059	1.011	6.9713	0.935	7.4354	0.835	8.3648	0.751	9.2942
5,600	1.244	8.1258	1.161	8.7070	1.089	9.2866	0.968	10.4474	0.871	11.6082
6,000	1.429	9.9918	1.333	10.7100	1.250	11.4221	1.111	12.8498	1.000	14.2776

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes—Continued

Velocity of Air in Feet per Minute	DIAMETER OF PIPE									
	44-inch		48-inch		52-inch		56-inch		60-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction
100	0.000	0.0001	0.000	0.0001	0.000	0.0001	0.000	0.0001	0.000	0.0001
200	0.001	0.0003	0.001	0.0006	0.001	0.0007	0.001	0.0007	0.001	0.0008
300	0.002	0.0020	0.002	0.0021	0.002	0.0023	0.002	0.0025	0.002	0.0027
400	0.001	0.0047	0.004	0.0051	0.003	0.0055	0.003	0.0059	0.003	0.0063
500	0.005	0.0091	0.006	0.0099	0.005	0.0107	0.005	0.0116	0.005	0.0124
600	0.009	0.0157	0.008	0.0171	0.008	0.0183	0.007	0.0200	0.007	0.0214
700	0.012	0.0249	0.011	0.0272	0.010	0.0295	0.010	0.0317	0.009	0.0340
800	0.016	0.0372	0.015	0.0403	0.014	0.0440	0.013	0.0474	0.012	0.0508
900	0.020	0.0530	0.019	0.0578	0.017	0.0626	0.016	0.0675	0.015	0.0723
1,000	0.025	0.0727	0.023	0.0793	0.021	0.0859	0.020	0.0925	0.019	0.0991
1,100	0.030	0.0968	0.028	0.1055	0.026	0.1141	0.024	0.1232	0.022	0.1320
1,200	0.036	0.1253	0.033	0.1371	0.031	0.1485	0.029	0.1599	0.027	0.1713
1,300	0.043	0.1597	0.039	0.1746	0.036	0.1888	0.034	0.2033	0.031	0.2178
1,400	0.049	0.1995	0.045	0.2177	0.042	0.2360	0.039	0.2539	0.035	0.2721
1,500	0.057	0.2454	0.052	0.2677	0.048	0.2900	0.045	0.3123	0.042	0.3346
1,600	0.065	0.2983	0.059	0.3249	0.055	0.3520	0.051	0.3790	0.047	0.4061
1,700	0.073	0.3572	0.067	0.3897	0.062	0.4220	0.057	0.4546	0.054	0.4871
1,800	0.082	0.4240	0.075	0.4626	0.069	0.5011	0.064	0.5406	0.060	0.5782
1,900	0.091	0.4987	0.084	0.5440	0.077	0.5890	0.072	0.6347	0.067	0.6800
2,000	0.101	0.5817	0.093	0.6346	0.085	0.6874	0.079	0.7403	0.074	0.7932
2,200	0.122	0.7742	0.112	0.8446	0.103	0.9150	0.096	0.9854	0.090	1.1607
2,400	0.145	1.0051	0.133	1.0965	0.123	1.1879	0.119	1.2793	0.107	1.3706
2,600	0.171	1.2779	0.156	1.3941	0.144	1.5103	0.134	1.6265	0.125	1.7427
2,800	0.198	1.5961	0.181	1.7412	0.168	1.8834	0.156	2.0314	0.145	2.1765
3,000	0.227	1.9632	0.208	2.1416	0.192	2.3201	0.179	2.4979	0.167	2.6771
3,200	0.259	2.3826	0.237	2.5002	0.219	2.8157	0.203	3.0324	0.190	3.2489
3,400	0.292	2.8578	0.268	3.1176	0.247	3.3764	0.229	3.6372	0.214	3.8970
3,600	0.327	3.3924	0.300	3.7007	0.279	4.0091	0.257	4.3239	0.240	4.6259
3,800	0.365	3.9897	0.334	4.3484	0.309	4.7519	0.287	5.0779	0.267	5.4406
4,000	0.404	4.6934	0.370	5.0765	0.342	5.4995	0.317	5.9226	0.296	6.3453
4,200	0.445	5.4669	0.408	5.8767	0.377	6.3661	0.350	6.8561	0.327	7.3458
4,400	0.487	6.1937	0.446	6.7568	0.414	7.3199	0.384	7.8829	0.357	8.4460
4,800	0.582	8.0411	0.533	8.7722	0.492	9.5032	0.457	10.2342	0.427	10.9642
5,200	0.683	10.2236	0.626	11.1530	0.578	12.0824	0.537	13.0119	0.501	13.9413
5,600	0.792	12.7690	0.726	13.9300	0.670	15.0907	0.622	16.2515	0.581	17.4123
6,000	0.909	15.7054	0.833	17.1331	0.769	18.5609	0.714	19.9885	0.667	21.4164

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes—Continued

Velocity of Air in Feet per Minute	DIAMETER OF PIPE									
	11-inch		12-inch		13-inch		14-inch		16-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction
100	0.001	0.0000	0.001	0.0000	0.001	0.0000	0.001	0.0000	0.001	0.0000
200	0.004	0.0001	0.004	0.0002	0.003	0.0002	0.003	0.0002	0.003	0.0002
300	0.009	0.0005	0.008	0.0005	0.008	0.0006	0.007	0.0006	0.006	0.0007
400	0.016	0.0012	0.015	0.0013	0.014	0.0014	0.013	0.0015	0.011	0.0017
500	0.025	0.0023	0.023	0.0025	0.021	0.0027	0.020	0.0029	0.017	0.0033
600	0.036	0.0039	0.033	0.0043	0.031	0.0046	0.029	0.0050	0.025	0.0057
700	0.049	0.0062	0.045	0.0068	0.041	0.0074	0.039	0.0079	0.034	0.0091
800	0.064	0.0093	0.059	0.0102	0.055	0.0109	0.051	0.0118	0.044	0.0135
900	0.081	0.0132	0.075	0.0145	0.069	0.0157	0.064	0.0169	0.056	0.0193
1,000	0.101	0.0182	0.092	0.0198	0.085	0.0215	0.079	0.0231	0.069	0.0264
1,100	0.122	0.0242	0.112	0.0264	0.103	0.0283	0.096	0.0308	0.084	0.0352
1,200	0.145	0.0314	0.133	0.0343	0.123	0.0371	0.114	0.0400	0.100	0.0457
1,300	0.170	0.0399	0.156	0.0437	0.144	0.0472	0.134	0.0508	0.117	0.0581
1,400	0.198	0.0499	0.181	0.0544	0.167	0.0589	0.156	0.0635	0.136	0.0726
1,500	0.227	0.0613	0.208	0.0669	0.192	0.0725	0.179	0.0781	0.156	0.0892
1,600	0.259	0.0735	0.237	0.0812	0.219	0.0880	0.203	0.0948	0.178	0.1083
1,700	0.292	0.0803	0.268	0.0974	0.247	0.1055	0.229	0.1137	0.207	0.1299
1,800	0.327	0.1060	0.300	0.1156	0.278	0.1253	0.257	0.1351	0.225	0.1542
1,900	0.365	0.1247	0.334	0.1360	0.308	0.1472	0.287	0.1587	0.251	0.1814
2,000	0.404	0.1454	0.370	0.1583	0.341	0.1719	0.317	0.1851	0.278	0.2115
2,200	0.489	0.1936	0.448	0.2111	0.413	0.2287	0.384	0.2463	0.336	0.2815
2,400	0.582	0.2513	0.533	0.2741	0.492	0.2970	0.457	0.3198	0.400	0.3455
2,600	0.683	0.3195	0.626	0.3485	0.578	0.3776	0.537	0.4063	0.468	0.4647
2,800	0.792	0.3990	0.726	0.4353	0.670	0.4716	0.622	0.5079	0.544	0.5804
3,000	0.909	0.4908	0.833	0.5354	0.769	0.5800	0.714	0.6245	0.625	0.7140
3,200	1.034	0.5956	0.948	0.6498	0.875	0.7039	0.813	0.7581	0.711	0.8364
3,400	1.168	0.7144	1.070	0.7794	0.988	0.8441	0.917	0.9093	0.827	1.0475
3,600	1.309	0.8481	1.200	0.9252	1.114	1.0023	1.029	1.0800	0.900	1.2335
3,800	1.459	0.9974	1.337	1.0871	1.234	1.1880	1.146	1.2695	1.003	1.4508
4,000	1.616	1.1734	1.481	1.2691	1.367	1.3749	1.270	1.4807	1.111	1.6922
4,200	1.782	1.3667	1.633	1.4692	1.508	1.5916	1.400	1.7140	1.225	1.9589
4,400	1.946	1.5484	1.784	1.6892	1.655	1.8300	1.537	1.9707	1.344	2.2522
4,800	2.327	2.0103	2.133	2.1930	1.969	2.3758	1.829	2.5585	1.600	2.9241
5,200	2.731	2.5559	2.504	2.7882	2.311	3.0206	2.146	3.2530	1.871	3.7177
5,600	3.168	3.1923	2.904	3.4825	2.680	3.7727	2.489	4.0629	2.178	4.6433
6,000	3.636	3.9263	3.333	4.2833	3.077	4.6402	2.857	4.9959	2.509	5.7110

Pressure and Horse-Power Required to Compensate for the Friction of Air Passing through Pipes—Concluded

Velocity of Air in Feet Per Minute	DIAMETER OF PIPE									
	18-inch		20-inch		22-inch		24-inch		26-inch	
	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction	Loss of Press. in oz. per sq. in.	H. P. lost in Friction
100	0.001	0.0000	0.001	0.0000	0.001	0.0000	0.000	0.0000	0.000	0.0000
200	0.002	0.0002	0.002	0.0003	0.002	0.0003	0.002	0.0003	0.002	0.0003
300	0.006	0.0008	0.005	0.0009	0.005	0.0010	0.004	0.0011	0.004	0.0012
400	0.010	0.0019	0.009	0.0021	0.008	0.0023	0.007	0.0025	0.007	0.0027
500	0.016	0.0037	0.014	0.0041	0.013	0.0045	0.012	0.0050	0.011	0.0054
600	0.022	0.0064	0.020	0.0071	0.018	0.0079	0.017	0.0086	0.015	0.0093
700	0.030	0.0102	0.027	0.0113	0.025	0.0125	0.023	0.0136	0.021	0.0147
800	0.040	0.0152	0.036	0.0169	0.032	0.0187	0.029	0.0203	0.027	0.0220
900	0.050	0.0217	0.045	0.0241	0.041	0.0265	0.037	0.0289	0.035	0.0313
1,000	0.062	0.0297	0.056	0.0330	0.051	0.0364	0.046	0.0397	0.043	0.0430
1,100	0.075	0.0396	0.067	0.0440	0.061	0.0484	0.056	0.0528	0.052	0.0572
1,200	0.089	0.0512	0.080	0.0571	0.073	0.0628	0.067	0.0685	0.062	0.0742
1,300	0.104	0.0654	0.094	0.0726	0.085	0.0799	0.078	0.0873	0.072	0.0944
1,400	0.121	0.0816	0.109	0.0907	0.099	0.0998	0.091	0.1088	0.084	0.1179
1,500	0.139	0.1004	0.125	0.1115	0.114	0.1227	0.104	0.1339	0.096	0.1450
1,600	0.158	0.1218	0.142	0.1354	0.129	0.1469	0.119	0.1624	0.109	0.1760
1,700	0.178	0.1461	0.161	0.1624	0.146	0.1786	0.134	0.1948	0.124	0.2110
1,800	0.200	0.1735	0.180	0.1927	0.164	0.2120	0.150	0.2313	0.139	0.2506
1,900	0.223	0.2040	0.201	0.2267	0.182	0.2494	0.167	0.2720	0.154	0.2945
2,000	0.247	0.2380	0.222	0.2644	0.202	0.2908	0.185	0.3173	0.171	0.3437
2,200	0.299	0.3167	0.269	0.3519	0.244	0.3871	0.224	0.4223	0.207	0.4575
2,400	0.356	0.4112	0.320	0.4569	0.291	0.5026	0.267	0.5483	0.246	0.5939
2,600	0.417	0.5228	0.376	0.5800	0.341	0.6390	0.313	0.6971	0.289	0.7552
2,800	0.484	0.6530	0.436	0.7255	0.396	0.7981	0.363	0.8706	0.335	0.9432
3,000	0.556	0.8031	0.500	0.8923	0.455	0.9816	0.417	1.0708	0.385	1.1601
3,200	0.632	0.9747	0.569	1.0830	0.517	1.1913	0.474	1.2996	0.438	1.4079
3,400	0.714	1.1690	0.642	1.2990	0.584	1.4289	0.535	1.5588	0.494	1.6882
3,600	0.800	1.4078	0.720	1.5420	0.655	1.6962	0.600	1.8504	0.557	2.0046
3,800	0.891	1.6342	0.802	1.8135	0.729	1.9949	0.669	2.1742	0.617	2.3760
4,000	0.988	1.9037	0.889	2.1152	0.808	2.3467	0.741	2.5382	0.684	2.7498
4,200	1.089	2.2037	0.980	2.4486	0.891	2.7335	0.817	2.9383	0.754	3.1832
4,400	1.189	2.5338	1.071	2.8153	0.973	3.0969	0.892	3.3784	0.827	3.6599
4,800	1.422	3.2896	1.280	3.6551	1.164	4.0206	1.067	4.3861	0.985	4.7516
5,200	1.670	4.1824	1.502	4.6471	1.366	5.1118	1.252	5.5765	1.156	6.0412
5,600	1.936	5.2237	1.742	5.8041	1.584	6.3845	1.452	6.9649	1.340	7.5453
6,000	2.222	6.4249	2.000	7.1388	1.818	7.8527	1.667	8.5666	1.538	9.2804

Factor Table for Reducing the Weight of Galvanized Iron Pipe of any Given Gauge to That of any Other Gauge

Gauge	Gauge and Weight in Pounds per Square Foot																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
	4.53	3.91	3.28	2.97	2.66	2.41	2.16	1.90	1.66	1.53	1.41	1.28	1.16	1.03	0.91	0.84	0.78
12	1.00	0.86	0.72	0.66	0.59	0.53	0.48	0.42	0.37	0.34	0.31	0.28	0.26	0.23	0.20	0.19	0.17
13	1.16	1.00	0.84	0.76	0.68	0.62	0.55	0.49	0.43	0.39	0.36	0.33	0.30	0.26	0.23	0.22	0.20
14	1.38	1.19	1.00	0.91	0.81	0.74	0.66	0.58	0.51	0.47	0.43	0.39	0.35	0.32	0.28	0.26	0.24
15	1.53	1.32	1.10	1.00	0.90	0.81	0.73	0.64	0.56	0.52	0.48	0.43	0.39	0.35	0.31	0.28	0.27
16	1.70	1.47	1.23	1.11	1.00	0.91	0.81	0.71	0.62	0.58	0.53	0.48	0.44	0.39	0.34	0.32	0.29
17	1.88	1.62	1.36	1.23	1.10	1.00	0.90	0.79	0.69	0.63	0.59	0.53	0.48	0.43	0.38	0.35	0.32
18	2.10	1.81	1.52	1.38	1.23	1.12	1.00	0.83	0.77	0.71	0.65	0.59	0.54	0.48	0.42	0.39	0.36
19	2.38	2.06	1.73	1.56	1.40	1.27	1.14	1.00	0.87	0.81	0.74	0.67	0.61	0.54	0.48	0.44	0.41
20	2.72	2.36	1.98	1.79	1.60	1.45	1.30	1.16	1.00	0.92	0.85	0.77	0.70	0.62	0.55	0.51	0.47
21	2.96	2.56	2.14	1.94	1.74	1.57	1.41	1.24	1.09	1.00	0.92	0.84	0.76	0.67	0.59	0.55	0.51
22	3.21	2.77	2.32	2.10	1.89	1.71	1.53	1.35	1.18	1.08	1.00	0.91	0.82	0.73	0.65	0.60	0.55
23	3.54	3.07	2.56	2.32	2.08	1.88	1.69	1.49	1.30	1.20	1.10	1.00	0.91	0.81	0.71	0.66	0.61
24	3.90	3.37	2.82	2.56	2.29	2.08	1.86	1.61	1.43	1.32	1.22	1.10	1.00	0.89	0.78	0.72	0.67
25	4.40	3.79	3.18	2.88	2.58	2.34	2.10	1.86	1.61	1.49	1.37	1.24	1.12	1.00	0.88	0.82	0.76
26	4.98	4.30	3.60	3.26	2.92	2.65	2.37	2.10	1.82	1.68	1.55	1.41	1.27	1.13	1.00	0.92	0.86
27	5.40	4.66	3.90	3.54	3.17	2.87	2.57	2.28	1.96	1.82	1.68	1.52	1.38	1.23	1.08	1.00	0.93
28	5.81	5.01	4.20	3.80	3.41	3.09	2.77	2.45	2.13	1.96	1.81	1.64	1.49	1.32	1.17	1.08	1.00

The table above serves for the estimation of weights of pipe of other gauges than those given in the preceding table. Thus, suppose it is desired to find the weight of 28-inch pipe made of No. 16 gauge. As indicated in the preceding table, pipe of this size made of No. 22 gauge weighs 11.4 pounds per running foot. By the table above, the figure found at the junction of the column headed **16** and the line designated **22** is 1.89; therefore, the weight per foot of No. 16 gauge is $11.4 \times 1.89 = 21.55$ pounds.

Equalization of Pipe Diameters

This table shows the relation of the combined area of small round air ducts or pipes to the area of one large main duct.

The bold figures at the top of the column represent the diameters of the small pipes or ducts; those in the left-hand vertical column are the diameters of the main pipes. The small figures show the number of small pipes that each main duct will supply.

EXAMPLE:—To supply sixteen 10-inch pipes: Refer to column having 10 at the top; follow down to small figure 16, thence left on the horizontal line of the boldface figure in the outside column, and we find that one 30 inch main will supply air for the sixteen 10-inch pipes.

	1	1																												
2	5.7	2																												
3	16	5.7	3																											
4	32	16	5.7	4																										
5	56	32	9.7	3.6	1.8	5																								
6	88	56	16	5.7	2.8	1.6	6																							
7	129	88	23	8.3	4.1	2.3	1.5	7																						
8	180	129	32	12	5.7	3.2	2.1	1.4	8																					
9	244	180	42	16	7.6	4.3	2.8	1.9	1.3	9																				
10	317	244	56	20	9.9	5.7	3.6	2.4	1.7	1.3	10																			
11	402	317	71	26	12	7.0	4.5	3.1	2.2	1.7	1.3	11																		
12	501	402	88	32	16	9.0	5.7	3.8	2.8	2.0	1.6	1.2	12																	
13	613	501	107	39	19	11	6.9	4.7	3.4	2.5	1.9	1.5	1.2	13																
14	737	613	129	47	23	13	8.3	5.7	4.1	3.0	2.3	1.8	1.5	1.2	14															
15	876	737	152	56	27	16	9.9	6.7	4.8	3.6	2.8	2.2	1.8	1.4	1.2	15														
16	1026	880	180	65	32	18	11	7.9	5.7	4.2	3.2	2.6	2.1	1.7	1.4	1.2	16													
17	1197	1026	208	76	37	21	13	9.2	6.6	4.9	3.8	3.0	2.4	2.0	1.6	1.4	1.2	17												
18	1375	1197	239	88	43	24	16	10	7.7	5.7	4.3	3.4	2.8	2.3	1.9	1.6	1.3	1.2	18											
19	1580	1375	275	100	49	28	18	12	8.8	6.5	5.0	3.9	3.2	2.6	2.2	1.8	1.5	1.3	1.2	19										
20	1775	1580	312	114	56	32	20	14	9.9	7.4	5.7	4.5	3.6	2.9	2.5	2.1	1.7	1.5	1.3	1.1	20									
21	1985	1785	345	130	61	35	22	15	10	8.4	6.3	5.2	4.1	3.2	2.6	2.3	2.0	1.6	1.4	1.2	1.1	21								
22	2250	2025	398	145	71	41	26	18	13	9.3	7.2	5.7	4.5	3.7	3.1	2.6	2.2	1.9	1.7	1.4	1.3	1.1	22							
23	2525	2275	460	160	77	47	29	20	14	10	7.8	6.2	5.0	4.1	3.4	2.8	2.4	2.1	1.8	1.6	1.5	1.3	1.2	23						
24	2800	2525	493	180	88	50	32	22	16	12	8.9	7.6	5.7	4.6	3.8	3.2	2.9	2.4	2.1	1.8	1.6	1.4	1.3	1.2	24					
25	3060	2800	543	202	97	55	35	24	17	13	10	8.0	6.4	5.2	4.2	3.5	3.1	2.6	2.2	2.0	1.7	1.5	1.3	1.2	1.1	25				
26	3425	3200	590	219	108	62	39	27	19	14	11	8.6	6.9	5.7	4.7	4.0	3.4	2.9	2.5	2.2	1.9	1.7	1.5	1.3	1.2	1.1	26			
27	3738	3575	677	243	121	68	43	29	21	15	12	9.6	7.5	6.1	5.1	4.3	3.6	3.1	2.7	2.4	2.1	1.9	1.7	1.5	1.4	1.3	1.2	27		
28	4100	3925	725	265	129	74	48	32	23	17	13	10	8.3	6.8	5.7	4.8	4.1	3.5	3.0	2.6	2.3	2.1	1.8	1.6	1.5	1.3	1.2	1.1	28	
29	4440	4275	800	289	141	79	52	35	25	19	14	11	9.1	7.5	6.2	5.2	4.4	3.8	3.3	2.9	2.5	2.2	2.0	1.8	1.6	1.4	1.3	1.2	1.1	29
30	4808	4625	864	315	151	88	56	38	28	20	16	12	9.9	8.0	6.7	5.7	4.7	4.1	3.6	3.0	2.6	2.4	2.2	1.9	1.7	1.5	1.4	1.3	1.2	1.1
31	5312	5100	920	344	168	96	59	40	30	22	17	13	10	8.9	7.4	6.1	5.1	4.5	3.9	3.4	3.0	2.7	2.4	2.1	1.9	1.7	1.5	1.4	1.3	1.2
32	5631	5425	1070	374	181	103	63	42	32	23	18	14	11	9.3	8.0	6.5	5.7	4.8	4.2	3.7	3.2	2.8	2.5	2.3	2.0	1.8	1.6	1.5	1.4	1.3
33	6134	5900	1140	401	196	109	70	45	35	25	19	15	12	10	8.5	7.1	6.0	5.2	4.4	3.9	3.5	3.0	2.7	2.4	2.2	2.0	1.8	1.6	1.5	1.3
34	6675	6425	1208	433	212	119	76	51	37	27	21	16	13	11	9.1	7.6	6.4	5.5	4.8	4.2	3.7	3.3	2.9	2.6	2.4	2.1	1.9	1.7	1.6	1.5
35	7075	6800	1280	470	229	127	82	56	40	30	23	18	14	12	10	8.4	7.1	6.1	5.3	4.6	4.0	3.5	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.5
36	7735	7375	1357	497	242	138	88	60	43	32	25	19	16	13	11	9.3	7.9	6.9	6.0	5.3	4.6	4.0	3.6	3.2	2.9	2.6	2.3	2.1	1.9	1.8
37	8265	7875	1435	527	260	146	94	64	45	33	26	20	16	13	11	9.3	7.9	6.9	6.0	5.3	4.6	4.0	3.6	3.2	2.9	2.6	2.3	2.1	1.9	1.8
38	8715	8325	1525	575	279	157	100	68	49	37	29	22	18	14	12	10	8.6	7.4	6.3	5.5	4.8	4.3	3.8	3.4	3.1	2.8	2.5	2.3	2.1	1.9

Area and Circumference of Circles

Diameter Inches	AREA		CIRCUMFERENCE	
	Square Inches	Sq. Feet	Inches	Ft. & Dec.
1	.7854	.0054	3.1416	.2618
2	3.1410	.0218	6.2832	.5236
3	7.0680	.0491	9.4248	.7854
4	12.5660	.0873	12.5664	1.047
5	19.6350	.1364	15.708	1.309
6	28.2740	.1964	18.8496	1.571
7	38.4840	.2673	21.9911	1.833
8	50.2650	.3491	25.1327	2.094
9	63.617	.4418	28.2743	2.356
10	78.540	.5454	31.4159	2.618
11	95.033	.6600	34.5575	2.880
12	113.097	.7854	37.6991	3.142
13	132.732	.9218	40.8407	3.403
14	153.938	1.069	43.9823	3.665
15	176.715	1.227	47.1239	3.927
16	201.062	1.396	50.2655	4.189
17	226.980	1.576	53.4071	4.451
18	254.469	1.767	56.5487	4.712
19	283.529	1.969	59.6903	4.974
20	314.160	2.182	62.8319	5.236
21	346.361	2.405	65.9734	5.498
22	380.133	2.640	69.1150	5.760
23	415.476	2.885	72.2566	6.021
24	452.390	3.142	75.3982	6.283
25	490.875	3.409	78.5398	6.545
26	530.930	3.687	81.6814	6.807
27	572.556	3.976	84.8230	7.069
28	615.753	4.276	87.9646	7.330
29	660.521	4.587	91.1062	7.592
30	706.860	4.909	94.2478	7.854
31	754.769	5.241	97.3894	8.116
32	804.249	5.585	100.5312	8.378
33	855.300	5.940	103.6730	8.639
34	907.922	6.305	106.8140	8.901
35	962.115	6.681	109.9560	9.163
36	1017.870	7.069	113.0970	9.425
37	1075.210	7.467	116.2390	9.686
38	1134.120	7.876	119.3810	9.948
39	1194.590	8.296	122.5220	10.21
40	1256.640	8.727	125.6640	10.47
41	1320.250	9.168	128.8050	10.73
42	1385.440	9.621	131.9470	10.99
43	1452.200	10.084	135.0880	11.26
44	1520.530	10.559	138.2300	11.52
45	1590.430	11.044	141.3720	11.78
46	1661.900	11.534	144.5130	12.04
47	1734.940	12.048	147.6550	12.30
48	1809.560	12.566	150.7960	12.57
49	1885.740	13.095	153.9380	12.83
50	1963.500	13.635	157.0800	13.09

Diameter Inches	AREA		CIRCUMFERENCE	
	Square Inches	Sq. Feet	Inches	Ft. & Dec.
51	2043.	14.19	160.2	13.35
52	2124.	14.75	163.4	13.61
53	2206.	15.32	166.5	13.88
54	2290.	15.90	169.6	14.14
55	2376.	16.50	172.8	14.40
56	2463.	17.10	175.9	14.66
57	2552.	17.72	179.0	14.92
58	2642.	18.35	182.2	15.18
59	2734.	18.99	185.3	15.45
60	2827.	19.63	188.5	15.71
61	2922.	20.29	191.6	15.97
62	3019.	20.97	194.8	16.23
63	3117.	21.65	197.9	16.49
64	3217.	22.34	201.1	16.76
65	3318.	23.04	204.2	17.02
66	3421.	23.76	207.3	17.28
67	3526.	24.48	210.5	17.54
68	3632.	25.22	213.6	17.80
69	3739.	25.97	216.8	18.06
70	3848.	26.73	219.9	18.33
71	3959.	27.49	223.1	18.59
72	4072.	28.27	226.2	18.85
73	4185.	29.07	229.3	19.11
74	4301.	29.87	232.5	19.37
75	4418.	30.68	235.6	19.63
76	4536.	31.50	238.8	19.90
77	4657.	32.34	241.9	20.16
78	4778.	33.18	245.0	20.42
79	4902.	34.04	248.2	20.68
80	5027.	34.91	251.3	20.94
81	5153.	35.78	254.5	21.21
82	5281.	36.67	257.6	21.47
83	5411.	37.57	260.8	21.73
84	5542.	38.48	263.9	21.99
85	5675.	39.41	267.0	22.25
86	5809.	40.34	270.2	22.51
87	5945.	41.28	273.3	22.78
88	6082.	42.24	276.5	23.04
89	6221.	43.20	279.6	23.30
90	6362.	44.18	282.7	23.56
91	6504.	45.17	285.9	23.82
92	6648.	46.16	289.0	24.09
93	6793.	47.17	292.2	24.35
94	6940.	48.19	295.3	24.61
95	7088.	49.22	298.5	24.87
96	7238.	50.27	301.6	25.13
97	7390.	51.32	304.7	25.39
98	7543.	52.38	307.9	25.66
99	7698.	53.46	311.0	25.92
100	7855.	54.54	314.2	26.18

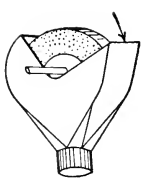
Sizes of Galvanized Iron Suction Pipes for Ordinary Wood-Working Machines

	Diameter Pipe in Inches	Diameter Pipe Upper Cylinder	Diameter Pipe Lower Cylinder	Diameter Pipe Side Cylinder
Planer and Matcher, 6 to 14 inch knives..	.....	6 inch	5 inch	5 inch
Moulder or Sticker.....	.....	6 "	4 "	4 "
Single Surfacer	.....	6–8 "	.....	.....
Double Surfacer	.....	6–8 "	5–6 inch	.....
Dimension Planer	.....	7–8 "	5–6 "	5–6 inch
Door Tenoner	.....	5–6 "	5–6 "	.....
Car Tenoner	.....	6–8 "	6–8 "	.....
Drum Sanders, 12 to 20 inch.....	4–5 inch	.....	.....	.....
" " 24 to 36 inch.....	5–6 "	.....	.....	.....
Sandpapering Machines	7–8 "	.....	.....	.....
Jointers or Buzz Planers, 8 to 16 inches...	4 "	.....	.....	.....
" " " " 20 to 30 inches...	5–6 "	.....	.....	.....
V Jointer	5 "	.....	.....	.....
Daniels Planer	6 "	.....	.....	.....
Diagonal Planer	7 "	.....	.....	.....
Rip and Re-Saws, 10 to 16 inch.....	4 "	.....	.....	.....
" " " 18 to 24 inch.....	5 "	.....	.....	.....
" " " 30 to 60 inch.....	6 "	.....	.....	.....
Band Re-Saws, small	4–5 "	.....	.....	.....
" " large.....	6–10 "	.....	.....	.....
Band Saws, small.....	3–4 "	.....	.....	.....
Gainers or Groove Saws.....	4 "	.....	.....	.....
Shapers (each Spindle).....	4–5 "	.....	.....	.....
Panel Raiser	.....	4 Inch	4 inch	.....
Sticker (small), Single Head.....	4–5 inch	.....	.....	.....
Dovetail Machine	5–6 "	.....	.....	.....
Sweep Pipes	6–9 "	.....	.....	.....

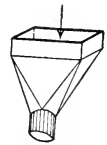
N. B.—The main suction pipe to fan should be equal in area to all of the branch pipes. Main discharge pipe should be equal in area to main suction pipe.

The above sizes of pipes will give excellent results where average length of pipe is not over twenty feet. For longer pipes, every additional twenty feet should have an additional increase of 10 per cent. in area of pipe.

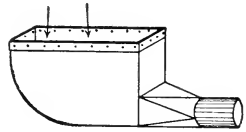
Hoods for Wood-Working Machines, etc.



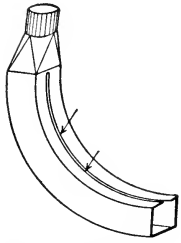
Hood for
Emery Wheel



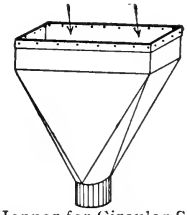
Jointer Hood



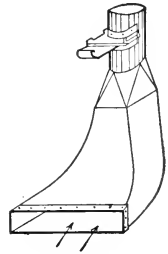
Resaw Hopper



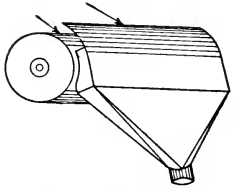
Hopper for Swing Saw



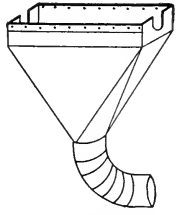
Hopper for Circular Saw



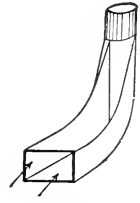
Floor Sweep-up



Hood for Sand Drum

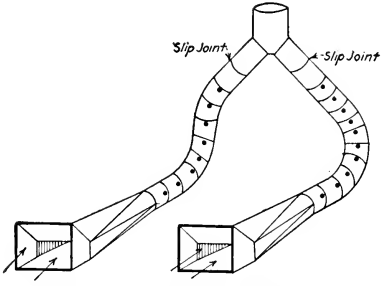


Lower Matcher Hood

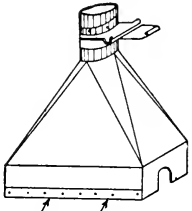


Sticker Hood

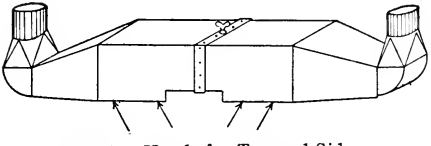
Hoods for Wood-Working Machines, etc.



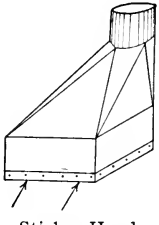
Shaper Hoods with Flexible Pipe



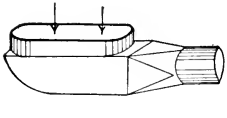
Upper Hood



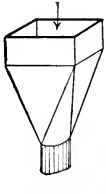
Matcher Hoods for Top and Sides



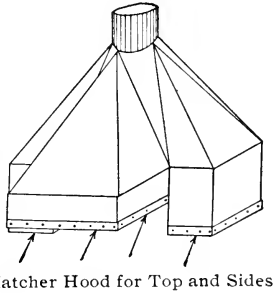
Sticker Hood



Hood for Berlin Sander



Sticker Hood



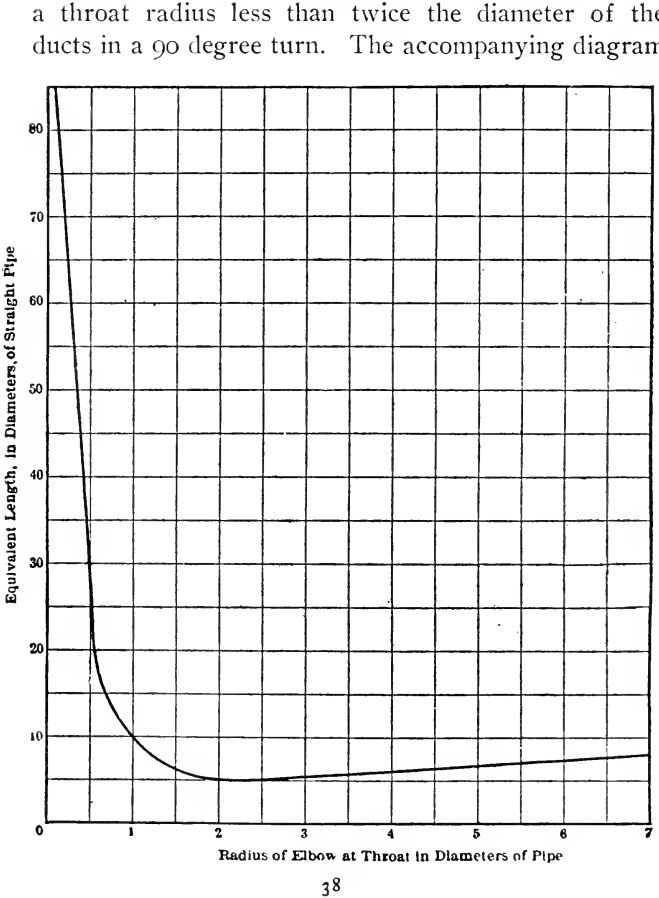
Matcher Hood for Top and Sides

Flue and Register Dimensions

SIZE OF FLUE		SIZE OF REGISTER		SIZE OF FLUE		SIZE OF REGISTER		SIZE OF FLUE		SIZE OF REGISTER	
Depth	Width	Width	Height	Depth	Width	Width	Height	Depth	Width	Width	Height
6	6	6	9	10	20	20	16	14	12	12	24
6	8	8	10	10	22	22	16	14	14	14	22
6	10	10	10	10	24	24	16	14	16	16	22
6	12	12	9	10	28	28	16	14	18	18	21
6	14	14	9	10	30	30	16	14	20	20	22
6	16	16	9					14	22	22	22
				12	8	8	18	14	24	24	22
8	6	6	12	12	10	10	18	14	26	26	22
8	8	8	12	12	12	12	18	14	28	28	22
8	10	10	12	12	14	14	18	14	30	30	22
8	12	12	12	12	16	16	18	14	36	36	22
8	14	14	12	12	18	18	18				
8	16	16	12	12	20	20	20	16	10	10	24
8	18	18	12	12	22	22	20	16	12	12	24
8	20	20	12	12	24	24	18	16	14	14	24
8	22	22	14	12	26	26	20	16	16	16	24
8	24	24	12	12	28	28	20	16	18	18	24
				12	30	30	18	16	20	20	24
9	9	9	14	12	36	36	18	16	22	22	24
9	10	10	14					16	24	24	24
9	12	12	14	13	9	9	20	16	30	30	24
9	14	14	14	13	12	12	20	16	32	32	24
9	16	16	14	13	14	14	20	16	36	36	24
9	18	18	14	13	16	16	20				
9	20	20	14	13	18	18	21	18	12	12	30
9	22	22	14	13	20	20	20	18	14	14	22
9	24	24	16	13	22	22	20	18	16	16	28
				13	24	24	20	18	18	18	27
10	8	8	16	13	26	26	20	18	20	20	28
10	10	10	16	13	28	28	20	18	22	22	28
10	12	12	16	13	30	30	20	18	24	24	27
10	14	14	16	13	36	36	20	18	28	28	28
10	16	16	16					18	30	30	28
10	18	18	16	14	10	10	24	18	36	36	28

Friction Effect of Elbows

THE effect of air friction through elbows in a ventilating system has considerable to do with its successful operation. No elbow should have a throat radius less than twice the diameter of the ducts in a 90 degree turn. The accompanying diagram



illustrates the relation between the radius of the elbow and the equivalent length of the straight ducts which that type of elbow represents. For example: An elbow of which the radius of the throat is equal to the diameter of the duct, is equivalent to a straight pipe of a length equal to ten times the diameter of the duct. With a 90 degree elbow, with a square heel or throat, the equivalent length is equal to that of a straight pipe 87 times the diameter of the duct. Too much stress cannot be placed upon this rule in the laying out of round or rectangular elbows.

Carrying Capacities of Round and Rectangular Air Pipes

THE relative carrying capacity of air pipes carrying heated air, as influenced by the shape of the air pipe, was discussed at some length at one of the lectures before a class in heating conducted by James A. Donnelly, at the Harlem Branch of the Y. M. C. A., New York. Mr. Donnelly has expanded his talk on this detail since that time and supplied the information given below, accompanied by a chart.

He considers that the relative carrying capacity of round and rectangular section pipes may be very closely estimated on the basis of formulas of the flow of fluids through pipes. He therefore goes to the Weisbach formula, which, he explains, states that the comparative carrying capacity for various forms or shapes of pipes is proportional to an expression which is the product of the area and the square root of the quotient of the area divided by the perimeter of the pipe. The perimeter is, of course, the distance around the pipe. If the pipes to be compared are all to have the same area then the carrying capacity of pipes of equal area, but of different shape, is proportional to the quotient of the square root of the perimeter divided by the perimeter.

To apply the foregoing, four different shape pipes have been considered, each with an area of 144 sq. in. A circle with a diameter of 13.54 in. has an area of 144 sq. in. Similarly a square duct 12 in. on a side has this area, also a rectangular duct 6 x 24 and one 4 x 36 in. The perimeter—that is, the circumference—of the

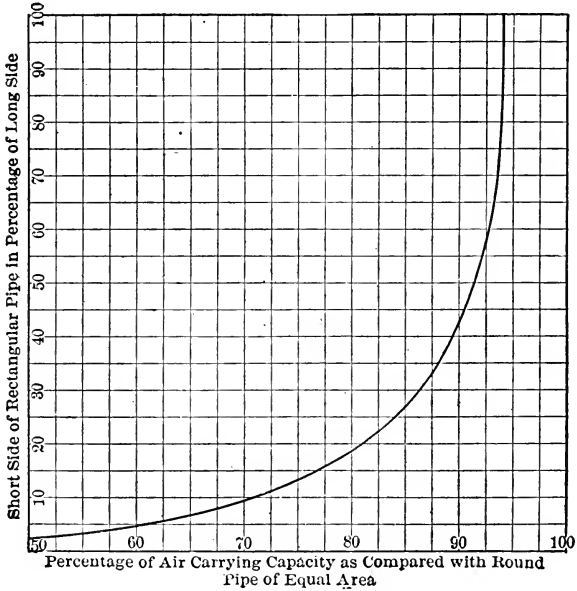
circle is equal to about 42.6 in., and the square root of 42.6 is equal to 6.52. Then 6.52, divided by 42.6, is equal to 0.153. The perimeter of the square pipe is 48; the square root of 48 is 6.93, and 6.93 divided by 48 is equal to 0.144. If we are to compare the carrying capacity of the different pipes with the circular pipe, we find that the relative carrying capacity of the square pipe, as compared with the round, is as 0.144 is to 0.153, or 0.94 to 1. This means that if the carrying capacity of the round pipe is regarded as 100 per cent., a square pipe of the same area, on account of its greater perimeter and the greater resistance which this interposes to the flow of air, passes only 94 per cent. as much air as will pass through the round pipe, all other conditions, such as temperature and pressure causing flow, being the same.

The perimeter of a 6 x 24-in. duct is 60 in., and the square root of 60 divided by 60 is 0.129. Similarly the perimeter of a 4 x 36-in. pipe is 80 and the square root of 80 divided by 80 is equal to 0.112. Therefore the carrying capacity of a 6 x 24-in. pipe, as compared with a circular pipe of the same area, is as 0.129 is to 0.153 or 84 per cent., and the relative carrying capacity of the 4 x 36-in. pipe is equal to $0.112 \div 0.53 = 0.73$, or 73 per cent.

On the basis of these figures a curved line may be drawn as shown in the accompanying chart. The horizontal lines indicate the percentage which the small dimension of a rectangular pipe bears to the large dimension, while the vertical lines correspond to the percentage of capacity for carrying the air which the

pipe has, as compared with the circular pipe of the same area.

With the square pipe the two sides are equal and thus the small dimension is equal to 100 per cent. of the large dimension. We find on the 100 per cent. line that the carrying capacity is 94 per cent., as already shown. In the case of a 6 x 24-in. pipe, the short dimension is one-quarter and therefore 25 per cent. of the larger dimension, and we find that the curve shows



that the carrying capacity is 84 per cent., as has also already been stated, of the equal size round pipe. Similarly an 8 x 18-in. pipe, which would have an area of

144 sq. in., has its shortest side equal to 44.4 per cent. of the longer side. Opposite to a line corresponding to 44 per cent. we find that the curve crosses a vertical line corresponding to about 90 per cent., showing that the 8 x 18-in. has 90 per cent. of the carrying capacity of an equal size round pipe.

Again, suppose the air pipe is 3½ x 41.2. This would have an area of about 144 sq. in. In this case the shorter side is 8½ per cent. of the longer side and the curve shows that the pipe has a carrying capacity no greater than 69 per cent. of an equal size round pipe. When it is remembered that pipes in these shallow constructions are oftentimes much reduced in area through carelessness in installation and through the pressure which they have to bear from plaster forced against them, some idea of the importance of the shape of the pipe is indicated. Comparing the 3½ x 41.2-in. pipe with, say, a 6 x 24-in. pipe, we find that their relative carrying capacities are 69 and 84 per cent., so that the shallower pipe, while having 69 per cent. of the carrying capacity of the round pipe, has about 82 per cent. of the carrying capacity of the 6 x 24-in. pipe.

The chart shows that there is no material falling off in the capacity of the pipes until the smaller dimension of the rectangular pipe falls somewhat below 50 per cent. of the larger dimension. Then the reduction in capacity is very marked.

Mr. Donnelly did not attempt to apply the formula for forms of pipe of the so-called oval in section, such as the flat pipes with rounded ends. He thinks that the results would vary but slightly from those shown, as

the perimeter of a flat pipe 6 x 24 in. is 60 in., while the perimeter of a 6-in. width pipe with 3-in. radius round ends would be about 57.4 in.

The foregoing tends to elucidate an important factor in the proportioning of systems of gravity heating, like the furnace system. It is common to use round pipes from the furnace to the wall pipes. If the wall pipes are given a proper size, then it is advantageous to have the round pipes somewhat larger. Unfortunately, many systems are designed with respect to the round pipe leaving the furnace and then some convenient size rectangular pipe is used, generally not larger than the round pipe. The foregoing shows that the square pipe has not the same carrying capacity as the round pipe, so that if the round pipe is of the minimum size, the rectangular wall pipe should be somewhat larger in cross sectional area.

WEIGHT OF WROUGHT IRON AND STEEL SHEETS

Weights per Square Foot. Thickness by American (Brown & Sharpe's) Gauge

No. of Gauge	Thickness in Inches	Iron	Steel
0000	.46	18.46	18.70
000	.4096	16.44	16.66
00	.3648	14.64	14.83
0	.3249	13.04	13.21
1	.2893	11.61	11.76
2	.2576	10.34	10.48
3	.2294	9.21	9.33
4	.2043	8.20	8.31
5	.1819	7.30	7.40
6	.1620	6.50	6.59
7	.1443	5.79	5.87
8	.1285	5.16	5.22
9	.1144	4.59	4.65
10	.1019	4.09	4.14
11	.0907	3.64	3.69
12	.0808	3.24	3.29
13	.0720	2.89	2.93
14	.0641	2.57	2.61
15	.0571	2.29	2.32
16	.0508	2.04	2.07
17	.0453	1.82	1.84
18	.0403	1.62	1.64
19	.0359	1.44	1.46
20	.0320	1.28	1.30
21	.0285	1.14	1.16
22	.0253	1.02	1.03
23	.0226	.906	.918
24	.0201	.807	.817
25	.0179	.718	.728
26	.0159	.640	.648
27	.0142	.570	.577
28	.0126	.507	.514
29	.0113	.452	.458
30	.0100	.402	.408
31	.0089	.358	.363
32	.0080	.319	.323
33	.0071	.284	.288
34	.0063	.253	.256
35	.0056	.225	.228

As there are many gauges in use differing from each other, and even the thickness of a certain specified gauge, as the Birmingham, is not assumed the same by all manufacturers, orders for sheets and wire should always state the weight per square foot, or the thickness in thousandths of an inch.

STEEL ANGLES
WEIGHTS AND DIMENSIONS OF STANDARD ANGLES
EQUAL LEGS

Dimensions	Thickness	Weight per Foot	Area of Section	Dimensions	Thickness	Weight per Foot	Area of Section
Inches	Inches	Lbs.	Sq. Ins.	Inches	Inches	Lbs.	Sq. Ins.
1/2 x 1/2	No. 3/32	.3	.....	2 x 2	1/8	1.7	.....
1/2 x 1/2	1/8	.4	.....	2 x 2	3/16	2.5	.72
				2 x 2	1/4	3.2	.94
5/8 x 5/8	3/32	.4	.....	2 x 2	5/16	4.0	1.16
5/8 x 5/8	1/8	.5	.....	2 x 2	3/8	4.7	1.36
				2 x 2	7/16	5.3	1.56
3/4 x 3/4	3/32	.5	.....				
3/4 x 3/4	1/8	.6	.17	2 1/4 x 2 1/4	1/8	1.9	.....
3/4 x 3/4	3/16	.9	.25	2 1/4 x 2 1/4	3/16	2.8	.81
				2 1/4 x 2 1/4	1/4	3.7	1.07
7/8 x 7/8	3/32	.5	.....	2 1/4 x 2 1/4	5/16	4.5	1.31
7/8 x 7/8	1/8	.7	.....	2 1/4 x 2 1/4	3/8	5.3	1.55
7/8 x 7/8	3/16	1.0	.....	2 1/4 x 2 1/4	7/16	6.1	1.78
				2 1/4 x 2 1/4	1/2	6.8	.....
1 x 1	No. 13	.6	.....				
1 x 1	1/8	.8	.24	2 1/2 x 2 1/2	1/8	2.1	.....
1 x 1	3/16	1.2	.34	2 1/2 x 2 1/2	3/16	3.1	.91
1 x 1	1/4	1.5	.44	2 1/2 x 2 1/2	1/4	4.1	1.19
				2 1/2 x 2 1/2	5/16	5.0	1.47
1 1/8 x 1 1/8	1/8	.9	.....	2 1/2 x 2 1/2	3/8	5.9	1.74
1 1/8 x 1 1/8	3/16	1.3	.....	2 1/2 x 2 1/2	7/16	6.8	2.00
				2 1/2 x 2 1/2	1/2	7.7	2.25
1 1/4 x 1 1/4	1/8	1.1	.30				
1 1/4 x 1 1/4	3/16	1.5	.44				
1 1/4 x 1 1/4	1/4	2.0	.57				
1 1/4 x 1 1/4	5/16	2.4	.69	2 3/4 x 2 3/4	1/8	2.3	.....
				2 3/4 x 2 3/4	3/16	3.4	1.00
1 1/2 x 1 1/2	3/32	.92	.....	2 3/4 x 2 3/4	1/4	4.5	1.32
1 1/2 x 1 1/2	1/8	1.3	.36	2 3/4 x 2 3/4	5/16	5.6	1.63
1 1/2 x 1 1/2	3/16	1.8	.53	2 3/4 x 2 3/4	3/8	6.6	1.93
1 1/2 x 1 1/2	1/4	2.4	.69	2 3/4 x 2 3/4	7/16	7.6	2.22
1 1/2 x 1 1/2	5/16	2.9	.84	2 3/4 x 2 3/4	1/2	8.5	2.50
1 1/2 x 1 1/2	3/8	3.4	.99				
1 3/4 x 1 3/4	1/8	1.4	.....	3 x 3	1/8	2.5	.....
1 3/4 x 1 3/4	3/16	2.2	.63	3 x 3	3/16	3.7	.....
1 3/4 x 1 3/4	1/4	2.8	.82	3 x 3	1/4	4.9	1.44
1 3/4 x 1 3/4	5/16	3.4	1.00	3 x 3	5/16	6.1	1.78
1 3/4 x 1 3/4	3/8	4.0	1.18	3 x 3	3/8	7.2	2.11
1 3/4 x 1 3/4	7/16	4.6	1.34	3 x 3	7/16	8.3	2.44

Standard Angles vary only by 1/16 inch.

STEEL ANGLES

WEIGHTS AND DIMENSIONS OF STANDARD ANGLES

EQUAL LEGS—Continued

Dimensions	Thickness	Weight per Foot	Area of Section	Dimensions	Thickness	Weight per Foot	Area of Section
Inches	Inches	Lbs.	Sq. Ins.	Inches	Inches	Lbs.	Sq. Ins.
3 x 3	$\frac{1}{2}$	9.4	2.75	5 x 5	$\frac{3}{4}$	23.6	.....
3 x 3	$\frac{9}{16}$	10.4	3.06	5 x 5	$\frac{13}{16}$	25.4	.....
3 x 3	$\frac{5}{8}$	11.5	3.36	5 x 5	$\frac{7}{8}$	27.2	.....
				5 x 5	$\frac{15}{16}$	28.9	.....
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{1}{4}$	5.8	.....	5 x 5	1	30.6	.....
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{5}{16}$	7.2	2.09				
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{3}{8}$	8.5	2.49	6 x 6	$\frac{3}{8}$	14.9	4.36
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{7}{16}$	9.8	2.88	6 x 6	$\frac{7}{16}$	17.2	5.06
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{1}{2}$	11.1	3.25	6 x 6	$\frac{1}{2}$	19.6	5.75
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{9}{16}$	12.4	3.63	6 x 6	$\frac{9}{16}$	21.9	6.44
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{5}{8}$	13.6	3.99	6 x 6	$\frac{5}{8}$	24.2	7.11
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{11}{16}$	14.8	4.34	6 x 6	$\frac{11}{16}$	26.5	7.78
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{3}{4}$	16.0	4.69	6 x 6	$\frac{3}{4}$	28.7	8.44
$3\frac{1}{2}$ x $3\frac{1}{2}$	$\frac{13}{16}$	17.1	5.03	6 x 6	$\frac{13}{16}$	31.0	9.09
				6 x 6	$\frac{7}{8}$	33.1	9.74
4 x 4	$\frac{1}{4}$	6.6	.....	6 x 6	$\frac{15}{16}$	35.3	10.38
4 x 4	$\frac{5}{16}$	8.2	2.41	6 x 6	1	37.4	11.00
4 x 4	$\frac{3}{8}$	9.8	2.86				
4 x 4	$\frac{7}{16}$	11.3	3.31	8 x 8	$\frac{1}{2}$	26.4	7.75
4 x 4	$\frac{1}{2}$	12.8	3.75	8 x 8	$\frac{9}{16}$	29.6	8.69
4 x 4	$\frac{9}{16}$	14.3	4.19	8 x 8	$\frac{5}{8}$	32.7	9.61
4 x 4	$\frac{5}{8}$	15.7	4.62	8 x 8	$\frac{11}{16}$	35.8	10.53
4 x 4	$\frac{11}{16}$	17.1	5.03	8 x 8	$\frac{3}{4}$	38.9	11.44
4 x 4	$\frac{3}{4}$	18.5	5.44	8 x 8	$\frac{13}{16}$	42.0	12.34
4 x 4	$\frac{13}{16}$	19.9	5.84	8 x 8	$\frac{7}{8}$	45.0	13.24
				8 x 8	$\frac{15}{16}$	48.1	14.13
5 x 5	$\frac{3}{8}$	12.3	3.61	8 x 8	1	51.0	15.00
5 x 5	$\frac{7}{16}$	14.3	4.19	8 x 8	$1\frac{1}{16}$	54.0	15.88
5 x 5	$\frac{1}{2}$	16.2	4.75	8 x 8	$1\frac{1}{8}$	56.9	16.74
5 x 5	$\frac{9}{16}$	18.1	5.31	8 x 8	$1\frac{1}{4}$	62.7	.....
5 x 5	$\frac{5}{8}$	20.0	5.86				
5 x 5	$\frac{11}{16}$	21.8	6.41				

Standard Angles vary only by $\frac{1}{16}$ inch.

STEEL ANGLES
WEIGHTS AND DIMENSIONS OF STANDARD ANGLES
UNEQUAL LEGS

Dimensions	Thickness	Weight per Foot	Area of Section	Dimensions	Thickness	Weight per Foot	Area of Section
Inches	Inches	Lbs.	Sq. Ins.	Inches	Inches	Lbs.	Sq. Ins.
1 x 5/8	1/8	.6	.....	2 1/2 x 1 1/4	5/32	2.0	.....
1 x 5/8	3/16	.9	.....				
1 x 3/4	1/8	.7	.....	2 1/2 x 1 1/2	3/16	2.4	.72
1 x 3/4	3/16	1.0	.....	2 1/2 x 1 1/2	1/4	3.2	.94
				2 1/2 x 1 1/2	5/16	3.9	1.16
1 3/8 x 7/8	1/8	0.9	.....	2 1/2 x 1 1/2	3/8	4.62	1.36
1 3/8 x 7/8	3/16	1.3	.....				
1 3/8 x 1	1/8	1.0	.....	2 1/2 x 1 3/4	3/16	2.6	.77
1 3/8 x 1	1/4	1.9	.....	2 1/2 x 1 3/4	1/4	3.4	1.00
1 1/2 x 1 1/4	3/16	1.6	.....	2 1/2 x 2	1/8	1.86	.....
1 1/2 x 1 1/4	1/4	2.1	.....	2 1/2 x 2	3/16	2.8	.81
				2 1/2 x 2	1/4	3.7	1.07
1 3/4 x 1 1/8	3/16	1.7	.....	2 1/2 x 2	5/16	4.5	1.31
1 3/4 x 1 1/8	1/4	2.2	.....	2 1/2 x 2	3/8	5.3	1 55
				2 1/2 x 2	7/16	6.1	1.78
1 3/4 x 1 1/4	1/8	1.2	.....	2 1/2 x 2	1/2	6.8	2.00
1 3/4 x 1 1/4	3/16	1.8	.....				
1 3/4 x 1 1/4	1/4	2.3	.....	3 x 2	3/16	3.1	.91
				3 x 2	1/4	4.1	1.19
2 x 1 3/8	3/16	2.1	.60	3 x 2	5/16	5.0	1.47
2 x 1 3/8	1/4	2.7	.79	3 x 2	3/8	5.9	1.74
				3 x 2	7/16	6.8	2.00
2 x 1 1/2	1/8	1.43	.43	3 x 2	1/2	7.7	2.25
2 x 1 1/2	3/16	2.1	.63				
2 x 1 1/2	1/4	2.8	.82	3 x 2 1/2	3/16	3.4	.....
2 x 1 1/2	5/16	3.4	1.00	3 x 2 1/2	1/4	4.5	1.32
				3 x 2 1/2	5/16	5.6	1.63
2 1/4 x 1 1/2	3/16	2.3	.....	3 x 2 1/2	3/8	6.6	1.93
2 1/4 x 1 1/2	1/4	3.0	.....	3 x 2 1/2	7/16	7.6	2.22
2 1/4 x 1 1/2	5/16	3.7	.....	3 x 2 1/2	1/2	8.5	2.50
2 1/4 x 1 1/2	3/8	4.4	.....	3 x 2 1/2	9/16	9.5	2.78
2 1/4 x 1 1/2	7/16	5.0	.....				
2 1/4 x 1 1/2	1/2	5.6	.....	3 1/4 x 1 5/8	3/16	3.1	.....

Standard Angles vary only by 1/16 inch.

STEEL ANGLES
WEIGHTS AND DIMENSIONS OF STANDARD ANGLES
UNEQUAL LEGS—Continued

Dimensions	Thickness	Weight per Foot	Area of Section	Dimensions	Thickness	Weight per Foot	Area of Section
Inches	Inches	Lbs.	Sq. Ins.	Inches	Inches	Lbs.	Sq. Ins.
3¼ x 2	¼	4.3	.....	4 x 3	⅜	8.5	2.49
3¼ x 2	5/16	5.3	.....	4 x 3	7/16	9.8	2.88
3¼ x 2	⅜	6.3	.....	4 x 3	½	11.1	3.25
3¼ x 2	7/16	7.2	.....	4 x 3	9/16	12.4	3.63
3¼ x 2	½	8.1	.....	4 x 3	⅝	13.6	3.99
3¼ x 2	9/16	9.0	.....	4 x 3	11/16	14.8	4.34
				4 x 3	¾	16.0	4.69
3½ x 2	5/16	5.6	.....	4 x 3	13/16	17.1	5.03
3½ x 2	⅜	6.6	.....				
				4 x 3½	5/16	7.7	2.25
3½ x 2½	¼	4.9	1.44	4 x 3½	⅜	9.1	2.68
3½ x 2½	5/16	6.1	1.78	4 x 3½	7/16	10.6	3.09
3½ x 2½	⅜	7.2	2.11	4 x 3½	½	11.9	3.50
3½ x 2½	7/16	8.3	2.44	4 x 3½	9/16	13.3	3.91
				4 x 3½	⅝	14.7	4.30
3½ x 2½	½	9.4	2.75	4 x 3½	11/16	16.0	4.69
3½ x 2½	9/16	10.4	3.06	4 x 3½	¾	17.3	.....
3½ x 2½	⅝	11.5	3.36	4 x 3½	13/16	18.5	.....
3½ x 2½	11/16	12.5	3.66			7.7	.....
				4½ x 3	5/16	9.1	2.68
3½ x 3	5/16	6.6	1.94	4½ x 3	⅜	10.6	3.09
3½ x 3	⅜	7.9	2.30	4½ x 3	7/16	11.9	3.50
3½ x 3	7/16	9.1	2.66	4½ x 3	½		
3½ x 3	½	10.2	3.00	4½ x 3	9/16	13.3	3.91
3½ x 3	9/16	11.4	3.34	4½ x 3	⅝	14.7	4.30
3½ x 3	⅝	12.5	3.68	4½ x 3	11/16	16.0	4.69
3½ x 3	11/16	13.6	4.00	4½ x 3	¾	17.3	.....
3½ x 3	¾	14.7	4.32	4½ x 3	13/16	18.5	.....
3½ x 3	13/16	15.8	4.63				
				5 x 3	5/16	8.2	2.41
4 x 2	5/16	6.2	.....	5 x 3	⅜	9.8	2.86
4 x 2	⅜	7.3	.....	5 x 3	7/16	11.3	3.31
				5 x 3	½	12.8	3.75
4 x 3	¼	5.8	.....	5 x 3	9/16	14.3	4.19
4 x 3	5/16	7.2	2.09	5 x 3	⅝	15.7	4.61

Standard Angles vary only by 1/16 inch.

STEEL ANGLES
WEIGHTS AND DIMENSIONS OF STANDARD ANGLES
UNEQUAL LEGS—Continued

Dimensions	Thickness	Weight per Foot	Area of Section	Dimensions	Thickness	Weight per Foot	Area of Section
Inches	Inches	Lbs.	Sq. Ins.	Inches	Inches	Lbs.	Sq. Ins.
5 x 3	11/16	17.1	5.03	6 x 3½	¾	22.4	6.57
5 x 3	¾	18.5	5.44	6 x 3½	13/16	24.0	7.06
5 x 3	13/16	19.9	5.84	6 x 3½	⅞	25.7	7.55
				6 x 3½	15/16	27.3	8.03
5 x 3½	5/16	8.7	2.56	6 x 3½	1	28.9	8.50
5 x 3½	⅜	10.4	3.05				
5 x 3½	7/16	12.0	3.53	6 x 4	⅜	12.3	3.61
5 x 3½	½	13.6	4.00	6 x 4	7/16	14.3	4.19
5 x 3½	9/16	15.2	4.47	6 x 4	½	16.2	4.75
5 x 3½	⅝	16.8	4.93	6 x 4	9/16	18.1	5.31
5 x 3½	11/16	18.3	5.38				
5 x 3½	¾	19.8	5.82	6 x 4	⅝	20.0	5.86
5 x 3½	13/16	21.3	6.25	6 x 4	11/16	21.8	6.41
5 x 3½	⅞	22.7	6.68	6 x 4	¾	23.6	6.94
				6 x 4	13/16	25.4	7.47
5 x 4	⅜	11.0	3.24	6 x 4	⅞	27.2	7.99
5 x 4	7/16	12.8	3.75	6 x 4	15/16	28.9	8.50
5 x 4	½	14.5	4.25	6 x 4	1	30.6	9.00
5 x 4	9/16	16.2	4.75				
5 x 4	⅝	17.8	5.24	7 x 3½	7/16	15.0	4.41
5 x 4	11/16	19.5	5.72	7 x 3½	½	17.0	5.00
				7 x 3½	9/16	19.1	5.59
5 x 4	¾	21.1	.....	7 x 3½	⅝	21.0	6.18
5 x 4	13/16	22.7	.....	7 x 3½	11/16	23.0	6.75
5 x 4	⅞	24.2	.....	7 x 3½	¾	24.9	7.32
				7 x 3½	13/16	26.8	7.88
6 x 3½	⅜	11.7	3.43	7 x 3½	⅞	28.7	8.43
6 x 3½	7/16	13.5	3.97	7 x 3½	15/16	30.5	8.97
6 x 3½	½	15.3	4.50	7 x 3½	1	32.3	9.50
6 x 3½	9/16	17.1	5.03				
6 x 3½	⅝	18.9	5.55	8 x 3½	½	18.7	.....
6 x 3½	11/16	20.6	6.06	8 x 3½	11/20	20.5	.....

Standard Angles vary only by 1/16 inch.

WEIGHT OF ROUND AND SQUARE STEEL PER LINEAL FOOT

Size in Inches	Round	Square	Size in Inches	Round	Square	Size in Inches	Round	Square
0 1/32	.0026	.0033	2	10.68	13.60	4	42.73	54.40
" 1/16	.0104	.0133	" 1/16	11.36	14.46	" 1/16	44.07	56.11
" 1/8	.0417	.0531	" 1/8	12.06	15.35	" 1/8	45.44	57.85
" 3/16	.0938	.1195	" 3/16	12.78	16.27	" 3/16	46.83	59.62
" 1/4	.1669	.2123	" 1/4	13.52	17.22	" 1/4	48.24	61.41
" 5/16	.2608	.3333	" 5/16	14.28	18.19	" 5/16	49.66	63.23
" 3/8	.3756	.4782	" 3/8	15.07	19.18	" 3/8	51.11	65.08
" 7/16	.5111	.6508	" 7/16	15.86	20.20	" 7/16	52.58	66.95
" 1/2	.6676	.8500	" 1/2	16.69	21.25	" 1/2	54.07	68.85
" 9/16	.8449	1.076	" 9/16	17.53	22.33	" 9/16	55.59	70.78
" 5/8	1.043	1.328	" 5/8	18.40	23.43	" 5/8	57.12	72.73
" 11/16	1.262	1.608	" 11/16	19.29	24.56	" 11/16	58.67	74.70
" 3/4	1.502	1.913	" 3/4	20.20	25.00	" 3/4	60.25	76.71
" 13/16	1.763	2.245	" 13/16	21.12	26.90	" 13/16	61.84	78.74
" 7/8	2.044	2.603	" 7/8	22.07	28.10	" 7/8	63.46	80.81
" 15/16	2.347	2.989	" 15/16	23.04	29.34	" 15/16	65.10	82.89
1	2.670	3.400	3	24.03	30.60	5	66.76	85.00
" 1/16	3.014	3.838	" 1/16	25.04	31.89	" 1/16	68.44	87.14
" 1/8	3.379	4.303	" 1/8	26.08	33.20	" 1/8	70.14	89.30
" 3/16	3.766	4.795	" 3/16	27.13	34.55	" 3/16	71.86	91.49
" 1/4	4.173	5.312	" 1/4	28.20	35.92	" 1/4	73.60	93.72
" 5/16	4.600	5.857	" 5/16	29.30	37.31	" 5/16	75.37	95.96
" 3/8	5.019	6.428	" 3/8	30.42	38.73	" 3/8	77.15	98.23
" 7/16	5.518	7.026	" 7/16	31.56	40.18	" 7/16	78.95	100.5
" 1/2	6.008	7.650	" 1/2	32.71	41.65	" 1/2	80.77	102.8
" 9/16	6.520	8.301	" 9/16	33.90	43.14	" 9/16	82.62	105.2
" 5/8	7.051	8.978	" 5/8	35.09	44.68	" 5/8	84.49	107.6
" 11/16	7.604	9.682	" 11/16	36.31	46.24	" 11/16	86.38	110.0

ESTIMATED WEIGHTS OF GALVANIZED SHEETS

U. S. Standard Gauge	10	12	14	16	18	20	22	24	25	26	27	28	29	30
Weight per sq. ft., lbs.	5.781	4.531	3.281	2.656	2.156	1.656	1.406	1.156	1.031	.9062	.8437	.7812	.7187	.6562
Weight per sq ft., oz.	92.5	72.5	52.5	42.5	34.5	26.5	22.5	18.5	16.5	14.5	13.5	12.5	11.5	10.5
Size of Sheet	Weight of Sheet—Pounds													
24 x 72	69	54	39	32	26	20	17	14	12	11	10	9	9	8
24 x 84	81	63	46	37	30	23	20	16	14	13	12	11	10	9
24 x 96	93	73	53	43	35	27	23	19	17	15	14	13	12	11
24 x 120	116	91	66	53	43	33	28	23	21	18	17	16	14	13
26 x 72	75	59	43	35	28	22	18	15	13	12	11	10	9	9
26 x 84	88	69	50	40	33	25	21	18	16	14	13	12	11	10
26 x 96	100	79	57	46	37	29	24	20	18	16	15	14	12	11
26 x 120	125	98	71	58	47	36	30	25	22	20	18	17	16	14
28 x 72	81	63	46	37	30	23	20	16	14	13	12	11	10	9
28 x 84	94	74	54	43	35	27	23	19	17	15	14	13	12	11
28 x 96	108	85	61	50	40	31	26	22	19	17	16	15	13	12
28 x 120	135	106	77	62	50	39	33	27	24	21	20	18	17	15
30 x 72	87	68	49	40	32	25	21	17	15	14	13	12	11	10
30 x 84	101	79	57	46	38	29	25	20	18	16	15	14	13	11
30 x 96	116	91	66	53	43	33	28	23	21	18	17	16	14	13
30 x 120	145	113	82	66	54	41	35	29	26	23	21	20	18	16
36 x 72	104	82	59	48	39	30	25	21	19	16	15	14	13	12
36 x 84	121	95	69	55	45	35	30	24	22	19	18	16	15	14
36 x 96	139	109	79	64	52	40	34	28	25	22	20	19	17	16
36 x 120	173	136	98	80	65	50	42	35	31	27	25	23	22	20
42 x 72	121	95	71	56	45	34	29	24	22	19	18	16	15	14
42 x 84	142	111	80	65	53	41	34	28	25	22	21	19	18	16
42 x 96	162	127	92	74	60	46	39	32	29	25	24	22	20	18
42 x 120	202	159	115	93	75	58	49	41	36	33	29	27	25	23
48 x 72	139	109	79	64	52	40	34	28	25	22	20	19	17	16
48 x 84	162	125	92	74	60	46	39	32	29	25	24	22	20	18
48 x 96	185	145	105	85	69	55	45	37	33	29	27	25	23	21
48 x 120	231	181	131	106	86	66	56	46	41	36	34	31	29	..

WEIGHT OF FLAT BAR STEEL PER LINEAL FOOT

Thickness in Inches	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 3/8	1 1/2	1 3/4	2	2 1/4	2 1/2	2 3/4	3	3 1/2	4	5	6	7
1/8	.213	.266	.320	.372	.426	.479	.530	.585	.640	.745	.850	.955	1.07	1.18	1.28	1.49	1.70	2.13	2.56	2.98
3/16	.319	.339	.480	.558	.639	.718	.790	.878	.960	1.12	1.28	1.43	1.60	1.76	1.92	2.24	2.55	3.20	3.83	4.47
1/4	.425	.533	.640	.743	.852	.958	1.06	1.17	1.28	1.49	1.70	1.91	2.13	2.34	2.56	2.98	3.40	4.26	5.11	5.96
5/16	.531	.665	.800	.929	1.06	1.20	1.33	1.46	1.60	1.86	2.13	2.39	2.66	2.92	3.19	3.72	4.25	5.32	6.38	7.44
3/8	.638	.798	.960	1.12	1.28	1.43	1.59	1.75	1.91	2.23	2.55	2.87	3.20	3.51	3.83	4.46	5.10	6.40	7.66	8.92
7/16	.744	.931	1.12	1.30	1.49	1.67	1.86	2.05	2.23	2.60	2.98	3.35	3.72	4.09	4.46	5.21	5.95	7.44	8.92	10.40
1/2	....	1.07	1.28	1.49	1.70	1.91	2.13	2.34	2.55	2.98	3.40	3.83	4.26	4.68	5.10	5.96	6.80	8.52	10.20	11.90
9/16	....	1.20	1.44	1.67	1.91	2.15	2.39	2.63	2.87	3.35	3.83	4.30	4.78	5.26	5.74	6.69	7.65	9.56	11.50	13.40
5/8	....	....	1.60	1.86	2.12	2.39	2.66	2.92	3.19	3.72	4.26	4.79	5.32	5.86	6.39	7.44	8.52	10.64	12.78	14.90
11/16	....	....	1.76	2.04	2.34	2.63	2.92	3.22	3.51	4.09	4.68	5.26	5.84	6.43	7.01	8.18	9.35	11.70	14.00	16.40
3/4	....	....	....	2.23	2.55	2.86	3.19	3.50	3.83	4.46	5.10	5.74	6.40	7.02	7.65	8.92	10.20	12.80	15.30	17.90
13/16	....	....	....	2.41	2.76	3.11	3.45	3.80	4.14	4.83	5.53	6.22	6.91	7.60	8.29	9.67	11.10	13.80	16.60	19.30
7/8	....	....	....	....	2.98	3.34	3.72	4.09	4.46	5.21	5.96	6.70	7.46	8.19	8.94	10.42	11.92	14.92	17.88	20.80
15/16	....	....	....	....	3.19	3.59	3.98	4.38	4.78	5.58	6.38	7.17	7.97	8.77	9.56	11.20	12.80	15.90	19.10	22.40
1	....	....	....	....	....	3.82	4.25	4.68	5.10	5.96	6.80	7.66	8.52	9.36	10.20	11.92	13.60	17.04	20.40	23.80
1 1/8	....	....	....	....	....	....	4.78	5.27	5.74	6.71	7.65	8.61	9.56	10.54	11.48	13.41	15.30	19.17	22.95	26.80
1 1/4	....	....	....	....	....	....	....	5.85	6.38	7.45	8.50	9.57	10.65	11.71	12.76	14.90	17.00	21.30	25.61	29.76
1 1/2	....	....	....	....	....	....	....	7.02	7.67	8.94	10.20	11.49	12.78	14.04	15.30	17.88	20.40	25.56	30.60	35.70

WEIGHT OF FLAT BAR IRON PER LINEAL FOOT

Thickness in inches	WIDTH IN INCHES															
	½	⅝	¾	⅞	1	1⅛	1¼	1⅜	1½	1⅝	1¾	1⅞	2	2⅛	2¼	2⅜
⅛	.211	.260	.316	.370	.417	.469	.521	.573	.625	.677	.729	.781	.833	.886	.938	.990
3/16	.361	420	.471	.551	.625	.703	.781	.859	.938	1.02	1.09	1.17	1.25	1.33	1.41	1.48
¼	.422	.510	.633	.730	.833	.938	1.04	1.15	1.25	1.36	1.46	1.56	1.67	1.77	1.88	1.98
5/16	.491	.640	.790	.915	1.04	1.17	1.30	1.43	1.56	1.69	1.82	1.95	2.08	2.21	2.34	2.47
⅜	.634	.784	.950	1.09	1.25	1.41	1.56	1.72	1.88	2.03	2.19	2.34	2.50	2.65	2.81	2.97
7/16	.....	.840	.990	1.25	1.46	1.64	1.82	2.09	2.18	2.37	2.55	2.73	2.92	3.10	3.28	3.46
½	.....	.900	1.26	1.46	1.67	1.87	2.08	2.29	2.50	2.71	2.92	3.12	3.33	3.54	3.75	3.96
⅝	.....	.....	1.58	1.82	2.08	2.34	2.60	2.86	3.13	3.30	3.65	3.91	4.17	4.43	4.65	4.95
¾	.....	.....	.....	2.19	2.50	2.81	3.13	3.44	3.75	4.06	4.38	4.69	5.00	5.31	5.63	5.94
⅞	.....	.....	.....	.....	2.92	3.28	3.65	4.01	4.38	4.74	5.10	5.47	5.83	6.20	6.56	6.93
1	.....	.....	.....	.....	3.33	3.75	4.17	4.58	5.00	5.42	5.83	6.25	6.67	7.08	7.50	7.92
1⅛	.....	.....	.....	.....	3.75	4.22	4.69	5.16	5.63	6.09	6.56	7.03	7.50	7.97	8.44	8.91
1¼	.....	.....	.....	.....	4.17	4.69	5.21	5.73	6.25	6.77	7.29	7.81	8.33	8.85	9.38	9.90
1⅜	.....	.....	.....	.....	4.58	5.16	5.73	6.30	6.88	7.45	8.02	8.59	9.17	9.74	10.31	10.89
1½	.....	.....	.....	.....	5.00	5.63	6.25	6.88	7.50	8.13	8.75	9.38	10.00	10.63	11.25	11.88
1⅝	.....	.....	.....	.....	5.42	6.09	6.77	7.45	8.13	8.80	9.48	10.16	10.83	11.51	12.19	12.86
1¾	.....	.....	.....	.....	5.83	6.56	7.29	8.02	8.75	9.48	10.21	10.94	11.67	12.40	13.13	13.85
1⅞	.....	.....	.....	.....	6.25	7.03	7.81	8.59	9.38	10.16	10.94	11.72	12.50	13.28	14.06	14.84
2	.....	.....	.....	.....	6.67	7.50	8.33	9.17	10.00	10.83	11.67	12.50	13.33	14.17	15.00	15.83

Calculations for Size of Furnace, Pipes and Registers

The equivalent glass-surface is equal to the area of windows and doors plus one-fourth that of the exposed wall expressed in square feet:

(1) To find area of grate in square inches: Divide equivalent glass-surface in square feet by 1.25 or multiply by 0.8.

(2) To find area of flue for any room in square inches: Divide equivalent glass-surface in square feet by 1.2 for first story, by 1.5 for second story, by 1.8 for third story.

(3) Make area of vent-flues 0.8 of hot-air flues.

(4) Make area of cold-air box 0.8 of given areas of flues.

(5) Take area of chimney smoke-flue in square inches as one-twelfth that of grate, with 1 in. added to each dimension.

This table gives different sizes of hot-air registers used in furnace-practice, together with the equivalents of the capacity of the same in round leader-pipes from furnace, with an elevation of at least 1 in. to the foot; also the equivalent in riser-pipes (or stacks), and also the cubic feet of space in first, second and third stories which said registers, with their proper round and square pipes, will heat. The table is based on normal conditions, with runs of pipe of usual length, and is intended to show the size of registers and pipes necessary to raise the temperature of air from zero outside to 70° F. inside, within reasonable time, without forcing. The sizes that are marked with an asterisk are those recommended for general use. The larger the register the less resistance to the flow of the heated air, but sizes mentioned will produce good results, and, being stock sizes, will always be found in stock.

In planning work arrange to use the sizes referred to. It should always be borne in mind, however, that uniform heating does not depend so much upon the *actual* sizes of the pipes as upon the *relative* sizes. For example, in a two-story house of eight rooms of *exactly the same size* and the same amount of wall and glass area the best heating results will be obtained not by using the same size of pipes for all the rooms, even if the pipes are of ample capacity, but by carefully proportioning the sizes of the pipes according to the exposure, length of the leaders, and location of the room in either the first or second story. The registers in the rooms with north and west exposures should be a little nearer the furnace, if possible, than the others, and the pipes to the first story should be larger than those leading to the second story. The International Heater Company states that 1 sq. in. of capacity of hot-air pipe will heat 50 cu. ft. in stores and 90 cu. ft. in churches when there is but one pipe directly over the furnace.

Dimensions of Registers and Boilers

Size of body, in.	Register		Border	
	Extreme dimensions, in	Depth open, in.	With ribs, floor opening, in	Tin-box size, in
4× 6	5⅝ × 7⅝	1¾	.....	.....
4× 8	5¼ × 9¼	2¼	.....	.....
4×10	5¼ ×11¾	2¼	.....	.....
4×13	5¼ ×14¼	2¼	.....	.....
4×15	5¼ ×16 3/16	2¼	.....	.....
4×18	5¼ ×19¼	2¼	.....	.....
5× 8	6⅜ × 9⅜	2	8⅛ ×11⅛	5 5/16 × 8 5/16
5×11	6⅜ ×12⅜	2	8⅛ ×14⅛	5 5/16 ×11 5/16
5×13	6⅜ ×14⅜	2	8⅛ ×16⅛	5 5/16 ×13 5/16
5×16	6⅜ ×17⅜	2	8⅛ ×19⅛	5 5/16 ×16 5/16
6× 6	7 1/16× 7 1/16	2⅜	9 9/16 × 9 9/16	6 9/16 × 6 9/16
6× 8	7 1/16× 9 1/16	2⅜	9 9/16 ×11 9/16	6 9/16 × 8 9/16
6× 9	7 1/16×10 1/16	2⅜	9 9/16 ×12 9/16	6 9/16 × 9 9/16
6×10	7 1/16×11 1/16	2⅜	9 9/16 ×13 9/16	6 9/16 ×10 9/16
6×14	7 1/16×15 1/16	2⅜	9 9/16 ×17 9/16	6 9/16 ×14 9/16
6×16	7 1/16×17 1/16	2⅜	9 9/16 ×19 9/16	6 9/16 ×16 9/16
6×18	7 1/16×19 1/16	2⅜	9 9/16 ×21 9/16	6 9/16 ×18 9/16
6×24	7 1/16×25 1/16	2⅜	9 9/16 ×27 9/16	6 9/16 ×24 9/16
7× 7	8 1/16× 8 1/16	2¾	10 9/16 ×10 9/16	7 9/16 × 7 9/16
7×10	8 1/16×11 1/16	2¾	10 9/16 ×13 9/16	7 9/16 ×10 9/16
8× 8†	9¾ × 9¾	3	11⅞ ×11⅞	8⅝ × 8⅝
8×10	9¾ ×11¾	3	11⅞ ×13⅞	8⅝ ×10⅝
8×12†	9¾ ×13¾	3	11⅞ ×15⅞	8⅝ ×12⅝
8×15	9¾ ×16 1/16	3	11⅞ ×18⅞	8⅝ ×15⅝
8×18	9¾ ×19¾	3	11⅞ ×21⅞	8⅝ ×18⅝
8×21	9¾ ×22¾	3	11⅞ ×24⅞	8⅝ ×21⅝
8×24	9¾ ×25¾	3	11⅞ ×27⅞	8⅝ ×24⅝
9× 9	10⅞ ×10⅞	3¼	13 1/16 ×13 1/16	9 1/16× 9 1/16
9×12†	10⅞ ×13¾	3¼	13 1/16 ×16 1/16	9 1/16×12 1/16
9×13	11 ×15	3¼	13 1/16 ×17 1/16	9 1/16×13 1/16
9×14†	10⅞ ×15⅞	3¼	13 1/16 ×18 1/16	9 1/16×14 1/16
9×16	10⅞ ×17 13/16	3¼	13 1/16 ×20 1/16	9 1/16×16 1/16
9×18	10⅞ ×19⅞	3¼	13 1/16 ×22 1/16	9 1/16×18 1/16
9×20	10⅞ ×21⅞	3¼	13 1/16 ×24 1/16	9 1/16×20 1/16
10×10	11 5/16×11 5/16	3⅜	14 3/16 ×14 3/16	10 1/16×10 1/16
10×12	11 5/16×13 5/16	3⅜	14 3/16 ×16 3/16	10 1/16×12 1/16
10×14	12 ×15 5/16	3⅜	14 3/16 ×18 3/16	10 1/16×14 1/16
10×16	11 5/16×17⅞	3⅜	14 3/16 ×20 3/16	10 1/16×16 1/16
10×18	11 5/16×19⅞	3⅜	14 3/16 ×22 3/16	10 1/16×18 1/16
10×20	11 5/16×21⅞	3⅜	14 3/16 ×24 3/16	10 1/16×20 1/16
12×12	14 1/16 ×14 1/16	4	16 7/16 ×16 7/16	12 13/16×12 13/16
12×14	14 1/16 ×16 1/16	4	16 7/16 ×18 7/16	12 13/16×14 13/16
12×15	13 13/16×16 1/16	4	16 7/16 ×19 7/16	12 13/16×15 13/16

Dimensions of Registers and Boilers

Size of body, in	Register		Border	
	Extreme dimensions, in	Depth open, in	With ribs, floor-opening, in	Tin-box size, in
12×16	14 1/16 × 18	4	16 7/16 × 20 7/16	12 13/16 × 16 13/16
12×17*	14 1/16 × 19	4	16 7/16 × 21 7/16	12 13/16 × 17 13/16
12×18	14 1/16 × 20 1/16	4	16 7/16 × 22 7/16	12 13/16 × 18 13/16
12×19	14 1/16 × 21 1/16	4	16 7/16 × 23 7/16	12 13/16 × 19 13/16
12×20	14 1/16 × 22	4	16 7/16 × 24 7/16	12 13/16 × 20 13/16
12×24	14 1/16 × 26	4	16 7/16 × 28 7/16	12 13/16 × 24 13/16
12×30	14 1/16 × 32	4	.....	.....
12×36	14 1/16 × 38	4	.....	.....
14×14	16 5/16 × 16 5/16	4	18 15/16 × 18 15/16	14 7/8 × 14 7/8
14×16	16 5/16 × 18 5/16	4	18 15/16 × 20 15/16	14 7/8 × 16 7/8
14×18	16 3/8 × 20 5/16	4	18 15/16 × 22 15/16	14 7/8 × 18 7/8
14×20	16 5/16 × 22 5/16	4	18 15/16 × 24 15/16	14 7/8 × 20 7/8
14×22	16 3/8 × 24 1/4	4	18 15/16 × 26 15/16	14 7/8 × 22 7/8
15×25	17 1 1/16 × 27 1 1/16	4 1/2	19 1 3/16 × 29 1 3/16	16 1/8 × 26 1/4
16×16	18 5/16 × 18 5/16	4 1/4	20 7/8 × 20 7/8	16 7/8 × 16 7/8
16×18	18 5/16 × 20 5/16	4 1/4	20 7/8 × 22 7/8	16 7/8 × 18 7/8
16×20	18 1/16 × 22 5/16	4 1/4	20 7/8 × 24 7/8	16 7/8 × 20 7/8
16×22	18 5/8 × 24 5/16	4 1/4	20 7/8 × 26 7/8	16 7/8 × 22 7/8
16×24	18 5/16 × 26 1 1/16	4 1/4	20 7/8 × 28 7/8	16 7/8 × 25 1/4
16×28	18 5/16 × 30 5/16	4 1/4	20 7/8 × 32 7/8	16 7/8 × 28 7/8
16×32	18 5/16 × 34 5/16	4 1/4	20 7/8 × 36 7/8	16 7/8 × 32 7/8
18×18	20 5/16 × 20 5/16	4 3/4	22 15/16 × 22 15/16	18 7/8 × 18 7/8
18×21	20 5/16 × 23 5/16	4 3/4	22 15/16 × 25 15/16	18 7/8 × 21 7/8
18×24	20 5/16 × 26 5/16	4 3/4	22 15/16 × 28 15/16	18 7/8 × 24 7/8
18×27	20 5/16 × 29 5/16	4 3/4	22 15/16 × 31 15/16	18 7/8 × 27 7/8
18×30	20 5/16 × 32 1/4	4 3/4	22 15/16 × 34 15/16	18 7/8 × 30 7/8
18×36	20 5/16 × 38 1/4	4 3/4	22 15/16 × 40 15/16	18 7/8 × 36 7/8
20×20	22 3/8 × 22 3/8	5 1/2	25 1/8 × 25 1/8	20 15/16 × 20 15/16
20×24	22 3/8 × 26 3/8	5 1/2	25 1/8 × 29 1/8	20 15/16 × 24 15/16
20×26*	22 3/16 × 28 5/8	5 1/2	25 1/8 × 31 1/8	20 15/16 × 26 15/16
21×29	23 3/8 × 31 3/8	5 1/2	26 1/8 × 34 1/8	21 15/16 × 29 15/16
24×24	26 7/16 × 26 7/16	5 3/8	29 1/2 × 29 1/2	24 15/16 × 24 15/16
24×27	26 7/16 × 29 3/8	5 3/8	29 1/2 × 32 1/2	24 15/16 × 27 15/16
24×30	26 7/16 × 32 3/4	5 3/8	29 1/2 × 35 1/2	24 15/16 × 30 15/16
24×32	26 7/16 × 34 3/8	5 3/8	29 1/2 × 37 1/2	24 15/16 × 32 15/16
24×36	26 7/16 × 38 3/8	5 3/8	29 1/2 × 41 1/2	24 15/16 × 36 15/16
24×45	26 7/16 × 47 3/8	5 3/8	29 1/2 × 50 1/2	24 15/16 × 45 15/16
27×27	29 7/16 × 29 7/16	6	32 1/2 × 32 1/2	27 15/16 × 27 15/16
27×38	29 7/16 × 40 3/8	6 1/2	32 1/2 × 43 1/2	27 15/16 × 38 15/16
30×30	32 3/8 × 32 3/8	7 3/4	35 1/2 × 35 1/2	30 15/16 × 30 15/16
30×36	32 3/8 × 38 3/8	7 3/4	35 1/2 × 41 1/2	30 15/16 × 36 15/16
30×42	32 3/8 × 44 3/8	7 3/4	35 1/2 × 47 1/2	30 15/16 × 42 15/16

Estimated Capacity of Pipes and Registers

ROUND PIPES

Diameter of pipe, in	Area, sq in	Diameter of pipe, in	Area, sq in	Diameter of pipe, in	Area, sq in
7	38	12	113	22	380
8	50	14	154	24	452
9	63	16	201	26	531
10	78	18	254	28	616
11	95	20	314	30	707

RECTANGULAR PIPES

Size of pipe, in	Area, sq in	Size of pipe, in	Area, sq in	Size of pipe, in	Area, sq in
4X 8	32	8X20	160	12X18	216
4X10	40	8X24	192	12X20	240
4X12	48	10X12	120	12X24	288
4X16	64	10X15	150	14X14	196
6X10	60	10X16	160	14X16	224
6X12	72	10X18	180	14X20	280
6X16	96	10X20	200	16X16	256
8X10	80	12X12	144	16X18	288
8X12	96	12X15	180	16X20	320
8X16	128	12X16	192	16X24	384

REGISTERS

Size of opening, in	Capacity, sq in	Size of opening, in	Capacity, sq in	Size of opening, in	Capacity, sq in
6X10	40	10X14	93	20X20	267
8X10	53	10X16	107	20X24	320
8X12	64	12X15	120	20X26	347
8X15	80	12X19	152	21X29	406
9X12	72	14X22	205	27X27	486
9X14	84	15X25	250	27X38	684
10X12	80	16X24	256	30X30	600

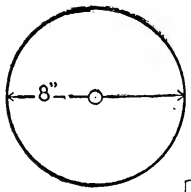
ROUND REGISTERS

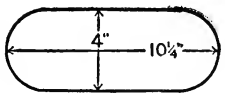
Size of opening, in	Capacity, sq in	Size of opening, in	Capacity, sq in	Size of opening, in	Capacity, sq in
7	26	12	75	20	209
8	33	14	103	24	301
9	42	16	134	30	471
10	52	18	169	36	679

SIZE AND AREAS OF ROUND PIPE OVALLED FOR USE IN WARM AIR HEATING

The right-hand column gives the size of pipe when ovalled. The area is given in left-hand column and the space pipe will occupy when ovalled in right-hand column under each size of pipe.

For example, 8″ pipe oval to 4 in. = 38 sq. in. area, and the width of space pipe will occupy is 10¼ in., that is to say: the 8-in. pipe is ovalled to 4 x 10¼ in. See Figs. 248 and 249. See page 317 for round pipe areas and circumferences.





Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Area	Width	Ovalled to
																198	17⅛	14 in.
														151	15⅛	189	18¼	12 "
												112	12⅝	147	15¾	181	18⅞	11 "
										94	11⅜	110	13⅛	141	16¼	173	19⅜	10 "
						78	10⅝	92	12⅛	106	13¾	134	16⅞	163	20			9 "
				63	9⅝	75	11⅛	88	12¾	101	14¼	126	17⅜	151	20⅝			8 "
		49	8⅝	60	10⅛	72	11¾	83	13¼	92	14⅞	115	18	137	21⅛			7 "
38	7⅝	47	9⅛	57	10¾	66	12¼	75	13⅞	85	15⅜	104	18⅝	123	21¾			6 "
35	8⅛	43	9¾	51	11¼	59	12⅞	67	14⅜	75	16	90	19⅛	106	22¼			5 "
31	8¾	38	10¼	44	11⅞	50	13⅜	57	15	63	16⅝	75	19¾	88	22⅞			4 "
26	9⅜	31	10⅞	36	12½	41	14⅛	45	15¾	50	17¼	59	20⅜	68	23½			3 "

Table of Dimensions of Dust Separators

Diameter of fan outlet in inches.	Area of fan outlet in square inches.	Openings in Separator.					Dimensions of Separator.			Shipping weight, Lbs.
		Size of inlet in inches.	Area of inlet in square inches.	Diameter of air outlet in inches.	Area of air outlet in square inches.	Diameter of dust outlet in inches.	Outside diameter of cylinder in inches.	Height of cylinder in inches.	Length of cone in inches.	
5.....	20	2½ x 9	23	8½	56	3	29½	14	26½	70
6.....	28	3 x 10½	32	10	78	4	35½	15½	32½	100
7.....	38									
or	or	3½ x 13	47	13	132	6	41½	18½	37½	140
8.....	50									
9.....	63	4½ x 16	72	15	176	6	47½	21	43½	175
10.....	78	5 x 18	90	17	227	6	53½	23	50	245
11.....	95									
or	or	5½ x 21	115	20	314	10	59½	26	56	315
12.....	113									
13.....	133									
or	or	6½ x 24	156	23½	433	10	65½	29	61½	395
14.....	154									
15	177	7 x 27	189	26	531	10	71½	32	67½	490
16.....	201									
or	or	8 x 30	240	28	615	10	77½	35	72½	575
17.....	227									
18.....	254	8½ x 32	272	31	754	10	83½	38	77½	715
19.....	283									
or	or	9 x 35	315	33	855	10	89½	41	82½	875
20	314									
21	346	9 x 40	360	36	1,017	10	93½	46	85½	930
22	380	10 x 41	410	39	1,194	10	97½	47	89	1,000
23...	415									
or	or	10½ x 43	451	41	1,320	11	101½	49	93	1,095
24.....	452									
25	491	11 x 45	495	44	1,520	11	105½	51	97	1,455
26.....	531	11 x 48	528	46	1,662	12	109½	54	99½	1,600
27.....	572	11 x 51	561	49	1,885	12	113½	57	103½	1,700
28.....	621	11½ x 54	621	52	2,123	12	117½	60	109½	1,855
29.....	660	12 x 57	684	55	2,375	12	121½	63	111½	2,035
30	707	12 x 60	720	58	2,642	12	125½	66	115½	2,155
31.....	754									
or	or	12½ x 63	807	61	2,922	13	129½	69	118½	2,250
32.....	804									
33.....	855	13 x 66	858	64	3,217	13	133½	72	122½	2,420
34.....	908	13½ x 69	932	67	3,525	13	137½	75	126½	2,555
35	962	14 x 72	1,008	70	3,848	14	141½	78	129½	2,745
36.....	1,017									
or	or	14½ x 75	1,087	73	4,185	14	145½	81	133½	2,900
37.....	1,075									
38.....	1,134	15 x 78	1,170	76	4,536	14	149½	84	137½	3,065
39.....	1,194									
or	or	15½ x 81	1,255	79	4,901	14	153½	87	141½	3,235
40.....	1,256									
41.....	1,320	16 x 84	1,344	82	5,281	14	157½	90	145½	3,395

Proportions of Standard Verrell Dust Collectors

No.	Diam. Pipe from Fan.	Area Of Dust Inlet.	B.	C.	D.	E.	F.	G.	H	Wgt. lb.
000	6	28								
00	7	38	32	26	37	7	6x7	10	12	70
0	8	50								
1	10	78	42	38	48	12	10x12	14	14	180
2	12	113	46	37	48	12	10x12	17	14	240
3	14	154	54	42	60	16	10x14	17	16	471
4	16	201	60	45	72	16	14x16	22	26	490
5	18	254	66	54	72	16	16x20	25	26	500
6	20	314	72	58	76	16	14x24½	27½	26	530
7	22	380	84	65	96	16	16x25	32	27	682
8	24	452	87	67	96	16	18x26	34	27	889
9	26	531	96	78	96	16	18x32	46	27	1,137
10	28	616	102	84	96	16	18x37½	40	27	1,250
11	30	707	111			16				1,500
12	32	804	114	90	120	16	22x41½	46	27	1,800
13	34	908	117	97	120	16	23x44	48	27	2,000
14	36	1,018	129	105½	120	16	24x45½	50	27	2,050
15	38	1,134	132½	111	120	16	26x44½	53	27	2,150
16	40	1,257								
17	42	1,385								

Proportion of Parts of Dust Separators

	OPENINGS			DIMENSIONS			
No. and Diam. of Inlet.	Size of Inlet. in	Diameter Air Outlet, in.	Diameter Dust Outlet, in.	Outside Diameter Cylinder, in.	Height Cylinder, in.	Length Cone, in.	Approximate weight, lb
5	2½x9	8½	3	29½	14	26½	70
6	3x10½	10	4	35½	15½	32½	100
7	3½x13½	13	6	41½	18½	37½	140
8	4½x16	15	6	47½	21	43½	175
9	5x18	17	6	53½	23	50	245
10	5½x21	20	10	59½	26	56	315
12	6½x24	23	10	65½	29	61½	395
13	7x27	26	10	71½	32	67½	490
14	8x30	28	10	77½	35	72½	575
16	8½x32	31	10	83½	38	77½	715
17	9x35	33	10.	89½	41	82½	875
18	9x40	36	10	93½	46	85½	930
20	10x41	39	10	97½	47	89	1,000
22	10½x43	41	11	101½	49	93	1,095
23	11x45	44	11	105½	51	97	1,455
24	11x48	46	12	109½	54	99½	1,600
25	11x51	49	12	113½	57	103½	1,700
26	11½x54	52	12	117½	60	109½	1,855
28	12x57	55	12	121½	63	111½	2,035
30	12x60	58	12	125½	66	115½	2,155
32	12½x63	61	13	129½	69	118½	2,250
34	13x66	64	13	133½	72	122½	2,420
36	13½x69	67	13	137½	75	126½	2,555
38	14x72	70	14	141½	78	129½	2,745
40	14½x75	73	14	145½	81	133½	2,900
42	15x78	76	14	149½	84	137½	3,065
44	15½x81	79	14	153½	87	141½	3,235
46	16x84	82	14	157½	90	145½	3,395

The above recommendations apply to shavings, but not to light buffing dust, etc., for which the separators must be selected to suit operating conditions.

Proportions of Main Duct in Dust Separation to Accommodate Branches

Number of branch pipes.	Diameter of Branch Pipes in inches.								
	3	3½	4	4½	5	5½	6	6½	7
	Area of each Branch Pipe in square inches.								
	7.07	9.62	12.566	15.9	19.635	23.758	28.274	33.183	38.485
	Area of each Branch Pipe plus 20% (square inches).								
	8.484	11.544	15.08	19.08	23.562	28.51	33.93	39.82	46.182
1	3⅜	3⅞	4⅜	5	5½	6	6⅝	7⅛	7⅝
2	4¼	5½	6½	7	7⅞	8⅝	9½	10⅛	10⅞
3	5⅛	6⅝	7⅝	8⅝	9½	10½	11½	12⅜	13⅛
4	6⅛	7⅞	8⅞	9⅞	11	12⅛	13⅛	14⅛	15⅜
5	7⅜	8⅝	9⅞	11	12⅛	13⅜	14⅝	16	17⅛
6	8⅛	9½	10⅜	12⅛	13½	14⅝	16⅛	17½	18⅝
7	8⅝	10⅛	11⅝	13⅛	14½	16	17½	18⅞	20⅛
8	9⅜	10⅞	12⅜	14	15½	17⅛	18⅝	20⅛	21⅝
9	9⅞	11⅝	13⅛	14⅞	16⅜	18⅛	19⅝	21⅜	23
10	10½	12⅛	13⅞	15⅝	17⅜	19⅛	20⅜	22⅝	24⅛
11	11	12⅞	14⅝	16⅜	18⅛	20	21⅞	23⅝	25⅝
12	11½	13⅜	15⅛	17⅛	19	20⅞	22⅜	24⅛	26⅝
13	11⅞	13⅞	15⅞	17⅞	19⅜	21⅜	23⅛	25⅛	27⅜
14	12⅝	14⅜	16⅛	18⅛	20⅛	22⅝	24⅝	26⅛	28¼
15	12⅞	14⅞	17	19⅛	21⅛	23⅛	25⅛	27⅝	29⅛
16	13¼	15⅜	17⅝	19⅞	22	24⅛	26⅜	28⅛	30⅜
17	13⅝	15⅞	18⅛	20⅛	22⅛	24⅞	27⅛	29⅜	31⅝
18	14	16⅜	18⅝	21	23⅛	25⅝	27⅞	30⅛	32⅝
19	14⅜	16⅞	19⅛	21½	23⅞	26¼	28⅜	31⅛	33⅞
20	14⅞	17⅛	19⅝	22⅛	24⅛	27	29⅛	31⅞	34⅞
21	15⅛	17⅝	20⅛	22⅝	25⅛	27⅝	30⅛	32⅝	35⅛
22	15½	18	20⅝	23⅛	25⅛	28⅜	30⅞	33⅛	36
23	15⅞	18⅛	21⅛	23⅞	26⅛	29	31⅛	34⅛	36⅞
24	16⅛	18⅞	21⅝	24⅛	26⅞	29⅝	32⅛	34⅞	37⅝
25	16⅝	19⅛	22	24⅞	27⅛	30⅛	32⅞	35⅝	38⅜
26	16⅞	19⅝	22⅜	25⅛	28	30⅞	33⅛	36⅜	39⅛
27	17⅛	20	22⅞	25⅞	28⅛	31⅜	34⅛	37	39⅞
28	17⅝	20⅛	23⅛	26⅛	29	32	34⅝	37⅜	40⅝
29	17⅞	20⅝	23⅝	26⅞	29½	32½	35⅛	38⅛	41⅜
30	18	21	24	27	30	33	36	39	42

PROPORTIONING GUTTERS AND CONDUCTORS TO THE ROOF SURFACE

The size of gutters and down-spouts and their distances apart, for roofs of mill buildings with a ¼ pitch and of different spans, are shown in the following table:

One-half roof-span, in feet	10	20	30	40	50	60	70	80
Size of gutter, in inches	5	5	6	6	7	7	8	8
Size of down-spouts, in inches.	3	3	4	4	5	5	6	6
Spacing of down-spouts, in feet.	50	50	50	50	40	40	40	40

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